

NOVEMBER 1960

# Machinery



Friction's worst enemy—  
**TIMKEN®** tapered roller bearings.

# NEW Model 322-A Bore-Matic

*new industry-standard design provides*

- ✓ HIGHER PRECISION
- ✓ EASIER SETUPS
- ✓ LOWER MAINTENANCE COSTS



Completely new from base to bridge, this double-end Bore-Matic meets all JIC standards—gives you new precision and economy for high production Borizing of medium to large size work.

Hydraulic valves and power unit are outside of the base, preventing thermal distortion, providing maximum accessibility and contributing to sustained high precision. Control valves, mounted on hydraulic manifold plates at each end of the machine, are of standard, interchangeable design, easily accessible and individually replaceable. Bridge setbacks are infinitely adjustable on slotted pads, permitting optimum relationship between work and tooling. And a full-length table pad increases the capacity of the machine.

For complete information on all the time-saving, labor-saving features of this versatile new machine, just call your Heald engineer, or send for Bulletin No: 2-322A.

#### PRECISION ROTARY INDEXING FIXTURE.

Shown on the machine above is a new electronically-controlled rotary indexing fixture, adjustable for any desired number of equally-spaced indexes from 4 to 500,000, permitting precision drilling or boring of accurately-spaced holes on one or more bolt circles. Holes with the same spacing are Borized in a fully automatic cycle, resetting the controls only when spacing is changed.

*It PAYS to come to Heald*

**THE HEALD MACHINE COMPANY**

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • Milwaukee • New York • Philadelphia • Syracuse



NOVEMBER 1960

VOL. 67 No. 3

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Published monthly by THE INDUSTRIAL PRESS.  
ROBERT B. LUCHARS, President; EDGAR A. BECKER, Vice-President and Treasurer; HAROLD L. GRAY, Secretary and Publishing Manager. Editorial, Advertising and Circulation Offices: 93 Worth St., New York 13, N. Y. Telephone, CANal 6-8120.

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Subscription rates: United States and Canada, one year, \$10; foreign countries, one year, \$15; two years, \$28. Single copies, \$1.00; foreign, \$1.50. Changes in address must be received by the tenth of the month to be effective for the next issue. Send old as well as new address. Copyright 1960 by THE INDUSTRIAL PRESS.

Accepted as controlled circulation publication at Bristol, Conn.

Great Britain

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# Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION  
IN THE MANUFACTURE OF METAL PRODUCTS

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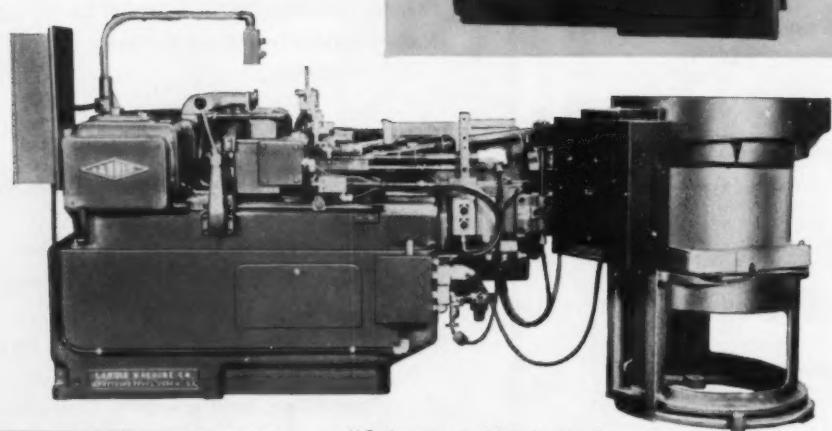
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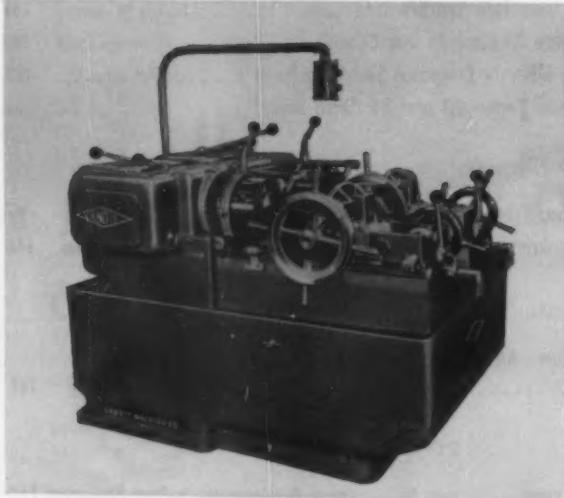
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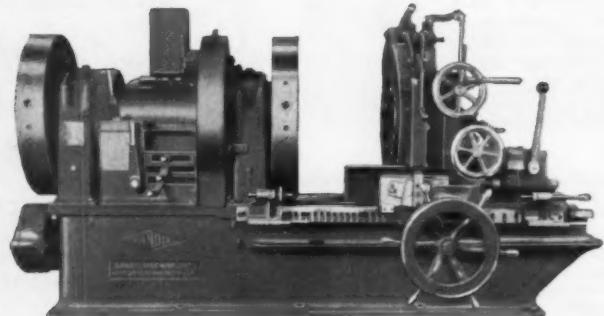
LANHYROL Thread Rolling Machine



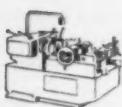
#2 Automatic Nipple Machine



12 Double LANDMACO Threading Machine



8 1/2" Receding Chaser Pipe Threading Machine



Threading Machines



Die Heads—  
Rotary & Stationary



Taps—Collapsible  
& Solid Adjustable



Centerless Thread  
Grinding Machines



Thread Rolling  
Tools



Thread Rolling  
Machines

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

## *How would you choose a threading machine?*

Would you consider the results to be obtained first? Or, would you consider how much it's going to cost first? Perhaps your first thought would be to check on the reliability of the manufacturer. Could be you are strictly a name-brand buyer.

Maybe you choose a threading machine because it has been recommended by a satisfied user such as the Landis Machine Company customer who realized a 90% saving in time threading power screws on a LANDMACO Threading Machine.

How you would choose a threading machine of course only you can answer. But doesn't it make good sense to buy from a world leader such as the LANDIS Machine COMPANY? All kinds and sizes of threading machines, thread rolling machines, pipe and nipple threading machines, thread grinders, pipe threading and cutting machines, and automatic coupling tapping machines to meet every threading requirement are available from Landis.

To put the accumulated knowledge of our over 55 years in the threading field to work for you is as close as your phone.

**LANDIS Machine COMPANY**  
WAVESBORG • PENNSYLVANIA

Centerless Thread Grinder

Actual  
Size

now you can check & record  
fine-pitch gear accuracy

# at 1600 magnifications

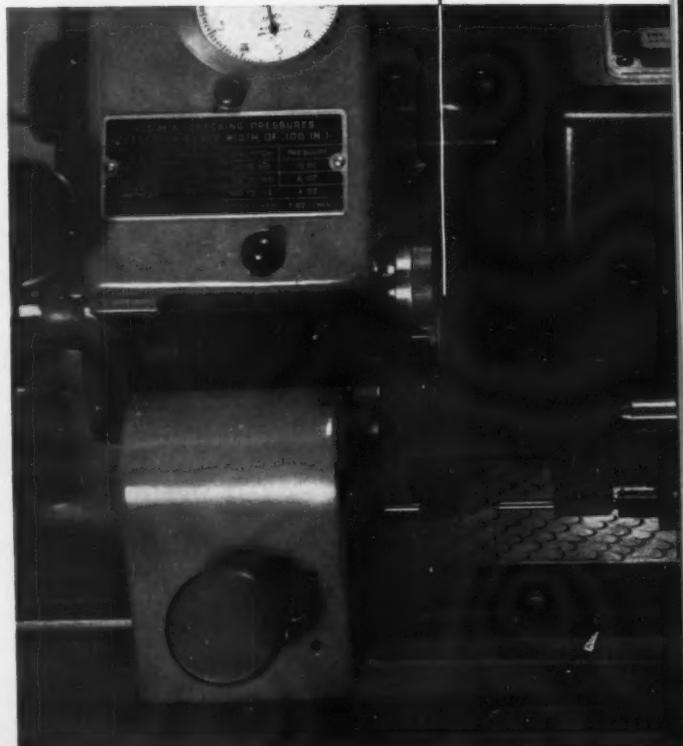
on the No. 4 Fellows Red Liner

Now, the No. 4 Red Liner makes "composite" checks on the finest instrument gears with unbelievable accuracy and sensitivity. 1600 to 1 magnifications are obtained with the electrical recording system which gives a written, unbiased record for instant reading or for proof-of-accuracy files.

One report states — "11 teeth, 200 D. P. pinion backed up to a 100 tooth gear on a cluster, checked easily on the No. 4 Red Liner."

The job shown is 96 pitch with 22 teeth on the small gear and 80 teeth on the larger gear. The pinion shaft rides in vees in a turret-type fixture.

Fellows inspection units cover a range from the tiniest instrument gear up to some that are 24 inches in diameter.



THE FELLOWS GEAR SHAPER COMPANY  
78 River Street, Springfield, Vermont  
Branch Offices:

1048 North Woodward Ave., Royal Oak, Mich.  
150 West Pleasant Ave., Maywood, N. J.  
5835 West North Avenue, Chicago 39  
6214 West Manchester Ave., Los Angeles 45



*Investigate the full line of inspection equipment*



No. 4 Fine-Pitch  
Red Liner



No. 8M  
Red Liner



No. 20M  
Red Liner



No. 12H Lead  
Measuring



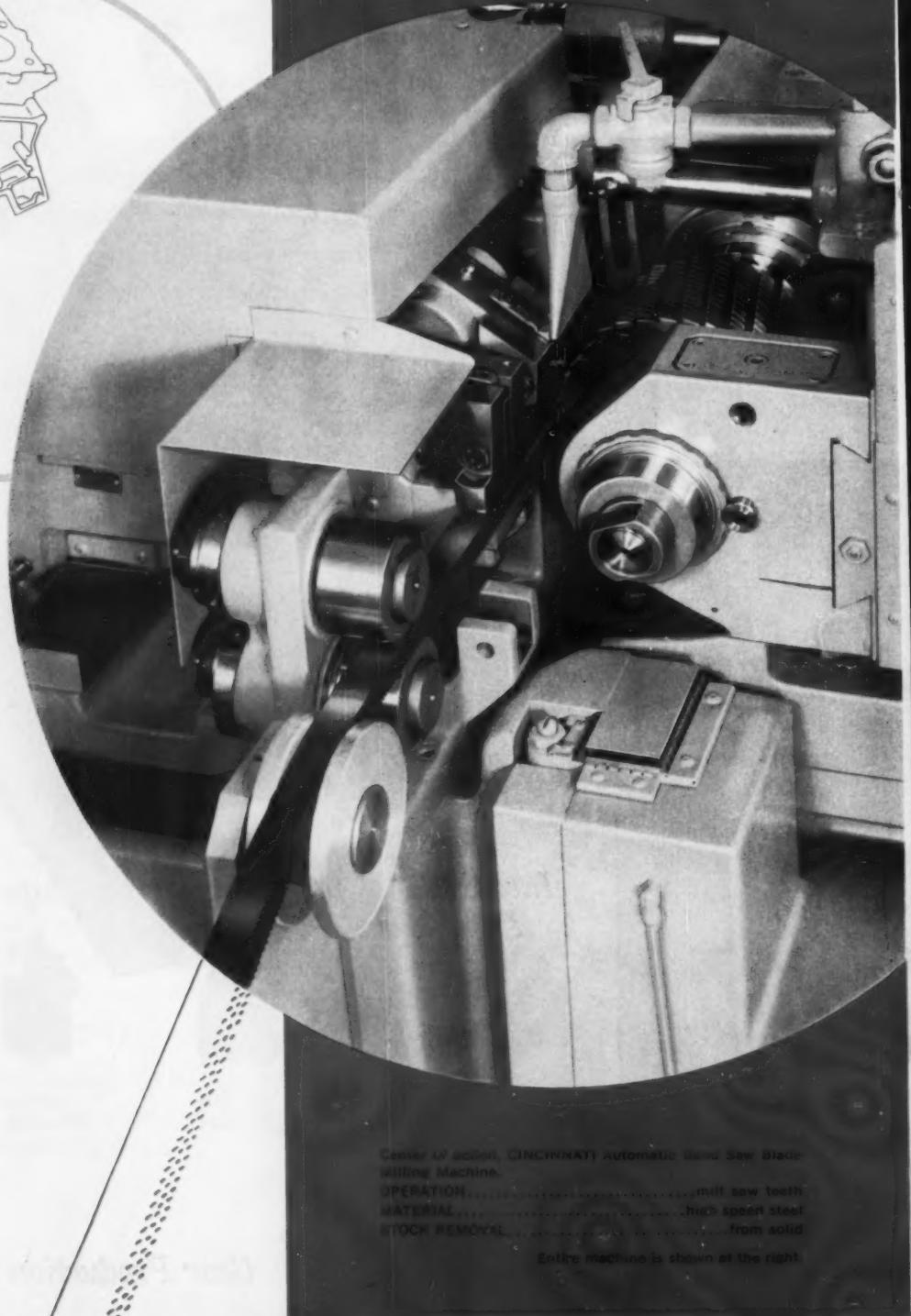
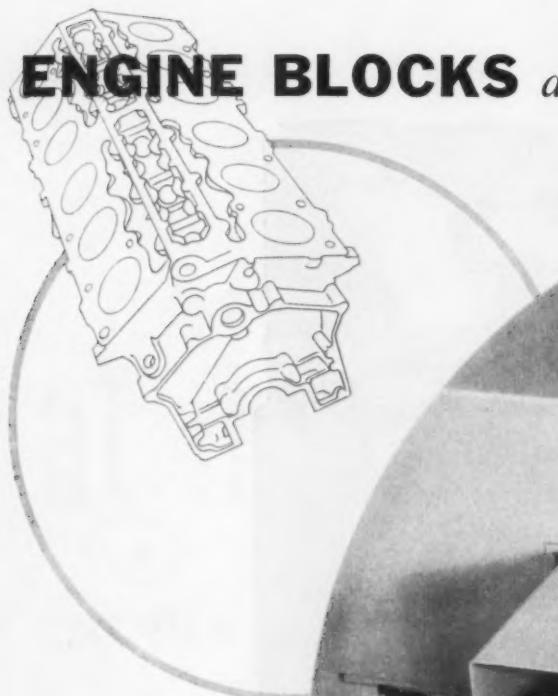
No. 12M Involute  
Measuring

THE  
PRECISION  
LINE

**Fellows**

Gear Production Equipment

# ENGINE BLOCKS and BAND SAW BLADES.



Center of action, CINCINNATI Automatic Band Saw Blade Milling Machine.

OPERATION.....mill saw teeth  
MATERIAL.....high speed steel  
STOCK REMOVAL.....from solid

Entire machine is shown at the right.

DESIGNERS AND BUILDERS OF SPECIAL MACHINES • VERTICAL AND HORIZONTAL BROACHING  
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

• • produced at lowest cost on machines built by

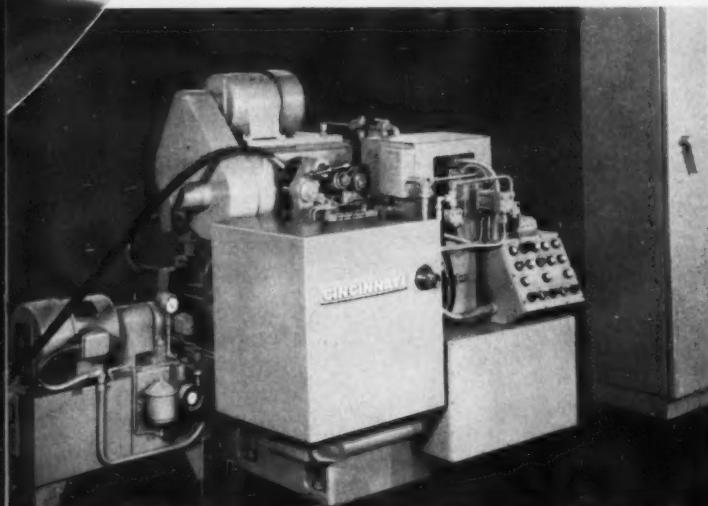
**CINCINNATI**

**SPECIAL  
MACHINE  
DIVISION**

Whatever the product, industry today shares a common problem . . . how to increase productivity and decrease costs. And the solution frequently is found in Cincinnati Milling's Special Machine Division, who design and build special machines and complete production lines for any industry.

Milling the teeth in band saw blades affords an interesting example of the Special Machine Division's dependable productivity. Their engineering specialists devised an automatic milling machine with a unique shuttling arrangement. In a completely automatic operation the stacked blades are advanced from reels by the shuttling action of the dual clamping fixture; saw teeth are milled with a 4" wide cutter, and a box milling cycle permits continuous clamping of the blades. The work advances for the next phase as the milling cycle is completed. The driving gear on the full size 50 Series machine spindle is larger than the cutter itself, delivering the maximum capacity built into the machine.

What's *your* machining problem? Whether it's a simple twist drill, a band saw blade, or a complex engine block requiring a completely engineered production line, the Special Machine Division is ready to serve you.



MACHINES • COMPLETELY AUTOMATED PRODUCTION LINES

**CINCINNATI**

**CINCINNATI**

SPECIAL MACHINE DIVISION

# LANDIS micro

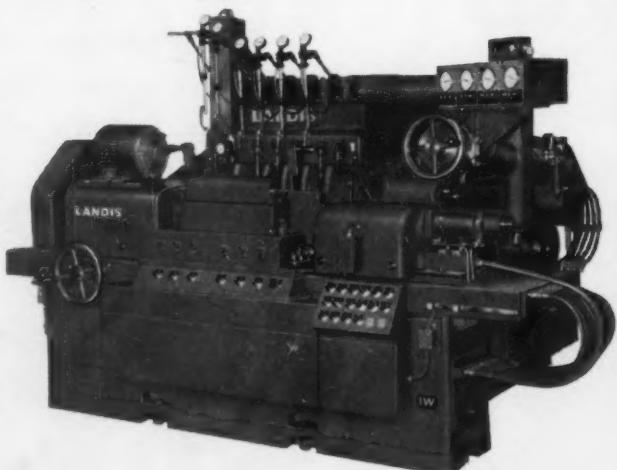
grinds more usable pieces...  
gives highest operating efficiency



A new Landis grinder with MICROFEED assures cylindrical grinding precision to your specified tolerances on a production basis.

MICROFEED is a new ultra-fine wheel feed to final size that automatically cancels the many variables that are common to all precision grinding feeds.

Semi-skilled operators using MICROFEED produce highest quality work.



## LANDIS precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

# feed



# GRAY



*horizontal milling and boring machines • planers • planer type milling machines*

*... cuts fast*

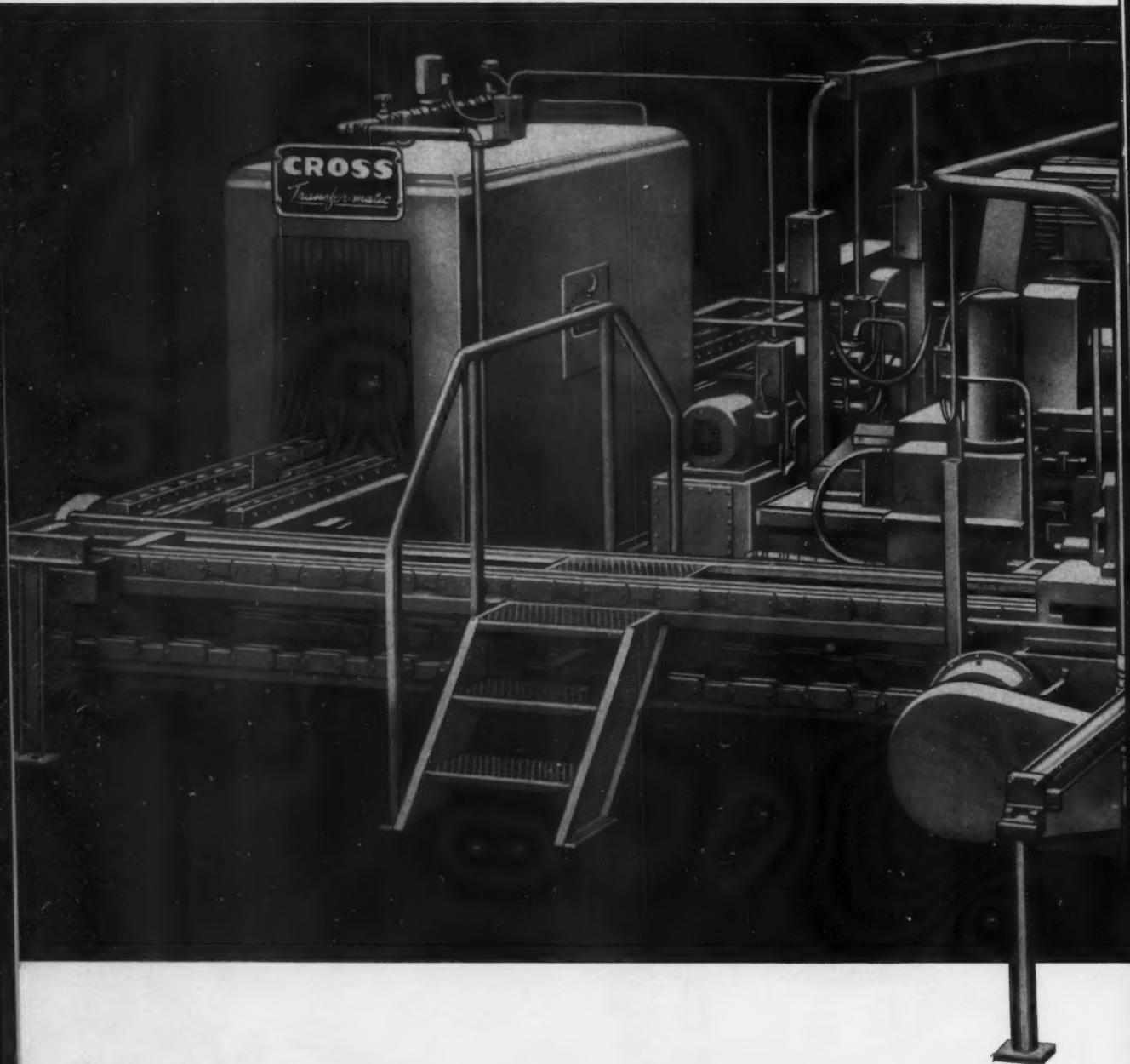
*..... cuts both ways*  
*..... cuts costs*



No idle return stroke makes this 108" x 84" x 30' GRAY UNIVERSAL PLANER the most productive planer ever built. Instantaneous change-over from standard to double cut planing. Simple standard carbide tooling. This big Gray single cuts, double cuts, triple cuts, and substantially cuts your set up and handling time.

The G. A. GRAY Co., Cincinnati, Ohio

## **Completely Machines Tractor Axle Housings**

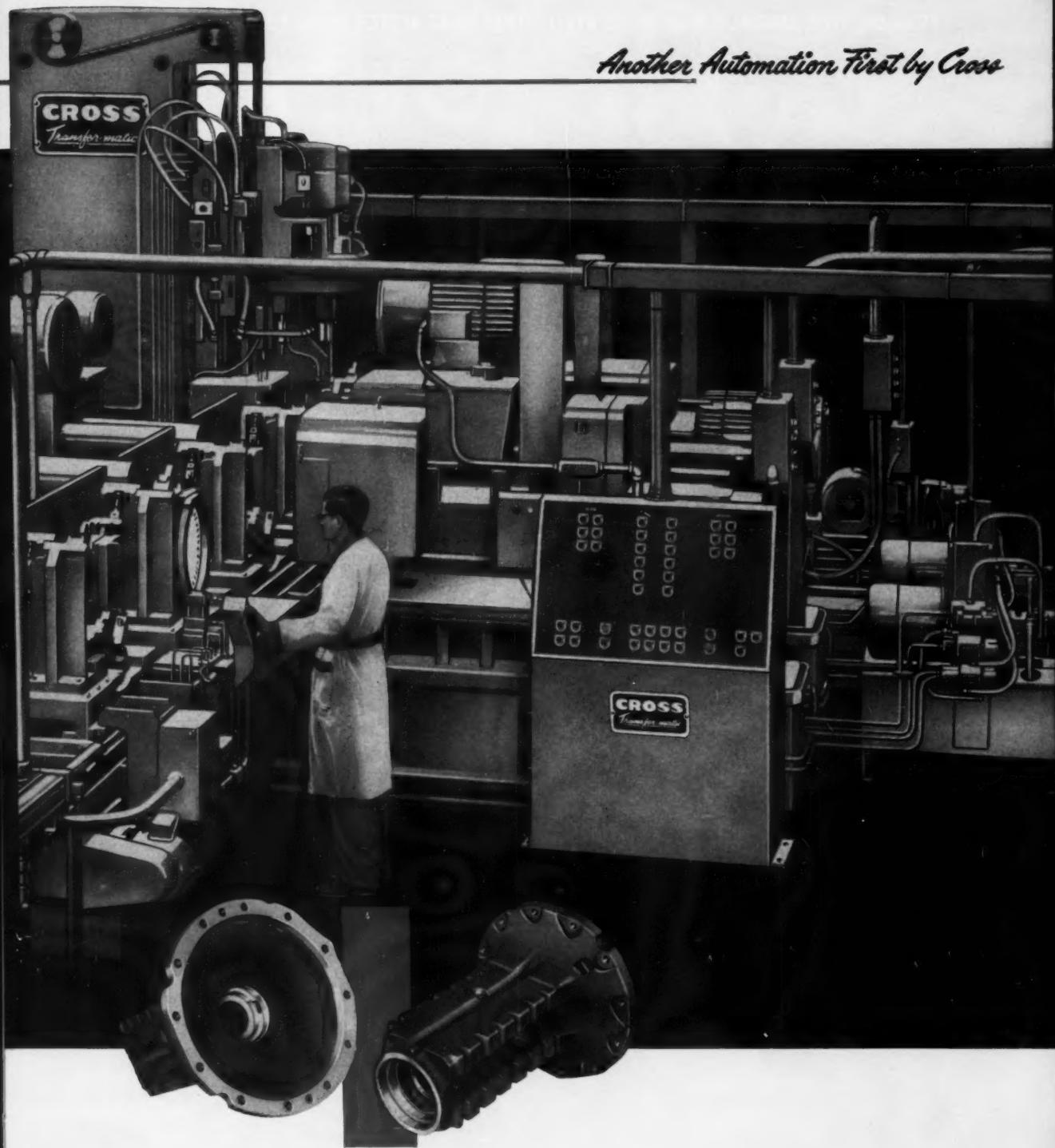


***Assures Concentricity  
and Squareness of  
Bearing Seats, Counter-Bore  
and Mounting Flange***

A significant breakthrough in processing of tractor rear axle housings has been accomplished by this new Transfer-matic which performs all machining operations.

An outstanding advantage of the machine is greater accuracy. Concentricity and squareness of the bearing seats, counter-bore and mounting flange are assured. Bore tolerances are  $\pm 0.0005$ . The concentricity, squareness, and center-distance tolerances between the bearing seats, faces and dowels is  $\pm 0.001$ . Close alignment between the two ends is maintained by doing all precision boring and the facing on both ends in one station.

*Another Automation First by Cross*



Four different housings weighing up to 175 pounds are processed with minor adjustments. Production requirements are up to 28 per hour for any of the four parts.

An unusual feature of the Transfer-matic is the use of two shuttle heads that index so that successive operations can be performed without moving the part. This design reduces the amount of capital investment required.

A Cross Sales Engineer will be glad to elaborate on these and other Cross developments.

Established 1898

THE **CROSS** CO.  
*First in Automation*  
PARK GROVE STATION • DETROIT 5, MICHIGAN

FROM CREATIVE CRUCIBLE: HIGH SPEED STEELS THAT MAKE BETTER TOOLS POSSIBLE



**AN INSPECTOR CHECKS A "BOTTOMING" TAP** for accuracy of the rake of the cutting face. Rex High Speed Steels help tapmakers produce the clean, accurate cutting edges so vitally needed in today's taps.

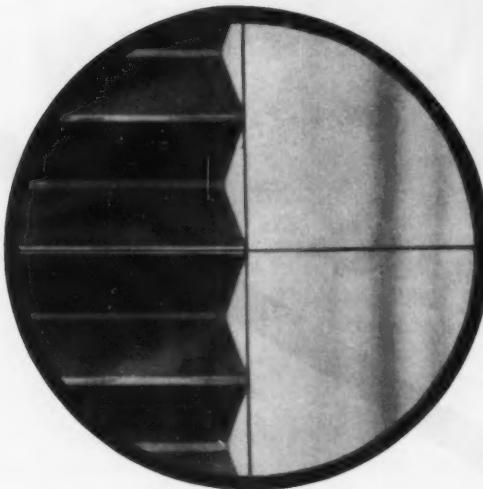
## TODAY'S TRUE-RUNNING TAPS "TIGHTEN-UP" TOLERANCES

*They produce more accurate threads — for closer fits*

*— because of continually-improved Rex® High Speed Steels*

The ground-thread taps you now use produce more accurate threads—and last longer—even when tapping tough abrasive materials or today's high-strength alloys.

There's a story behind this development of more accurate and productive taps. It's the story of the tapmakers' continuing research and increasing skill—combined with Crucible progress in making better high speed steels.



THE RAKE ANGLE of a  $\frac{3}{8}$ -10 H5 "bottoming" tap looks like this — when viewed through the rake measuring instrument shown at left.

**To produce the fine steels needed for taps,** Crucible tool steel specialists now use the most advanced electronic instrumentation available. For example: they can record the temperature of the molten metal in the melting furnace within 5 seconds. So, each heat is produced under identical temperature conditions.

**Crucible specialists employ new techniques** that also greatly improve deoxidation of the liquid steel. They use new ingot mold designs to minimize segregation. And they ultrasonically inspect every billet of Rex High Speed Steel before rolling or forging to ensure freedom from internal voids, flake, inclusions, etc.

For complete information on how Rex High Speed Steels can help make precision tools better, call or write Crucible branch office or service center near you.

BETTER TOOLS, THROUGH BETTER STEELS. The constant improvement of Rex High Speed Steels ensures the increasingly better performance of hobs, broaches, twist drills, cutters and taps.



**CRUCIBLE STEEL COMPANY OF AMERICA**

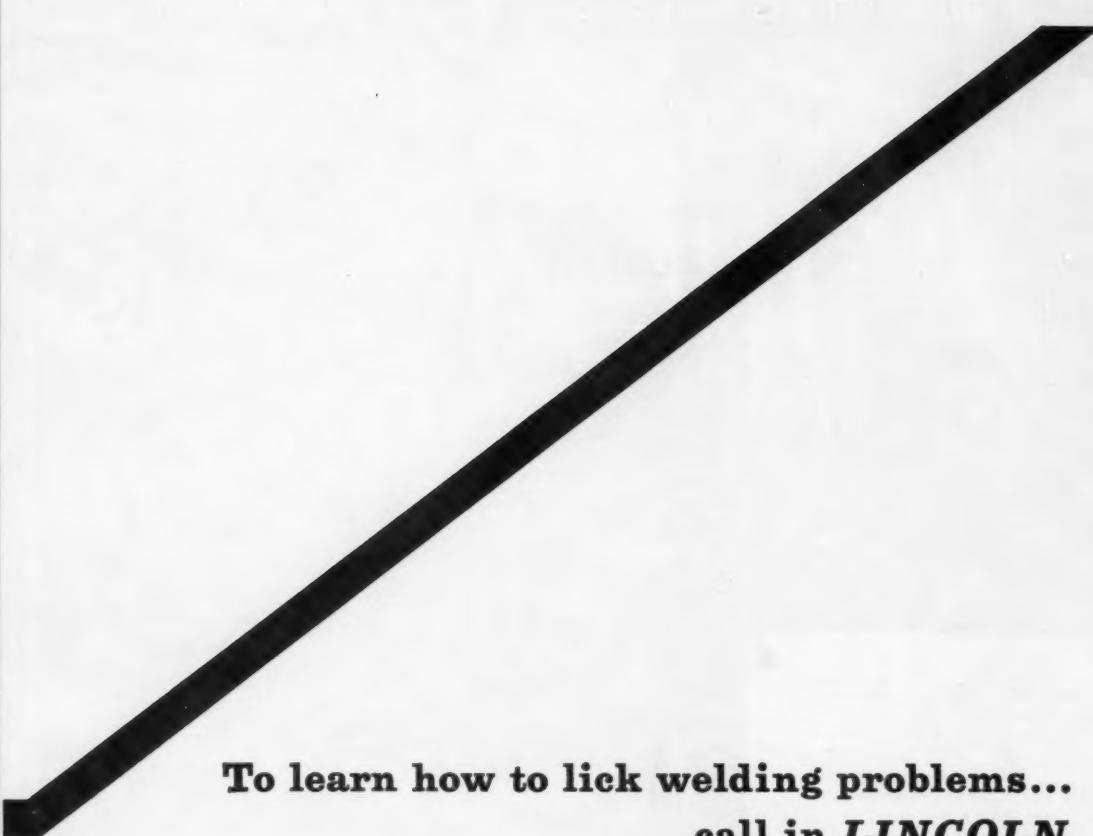
Branch Offices and Warehouses: Atlanta • Baltimore • Boston • Buffalo • Caldwell, New Jersey • Charlotte  
Chicago • Cincinnati • Cleveland • Columbus • Dallas • Dayton • Denver • Detroit • Erie, Pennsylvania • Grand Rapids • Houston • Indianapolis  
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Rockford • Salt Lake City • San Francisco • Seattle • Springfield, Massachusetts • St. Louis • East Syracuse • Tampa • Toledo • Tulsa

To learn how an Aardvark licks termites...  
call in a **ZOOLOGIST**

(specialist on animals)



A native of Africa, the AARDVARK is a large, nocturnal, burrowing mammal subsisting largely on termites and has a long extensible tongue for gathering them. He has heavy claws for ripping open rotten logs to find more termites.



**To learn how to lick welding problems...  
call in LINCOLN**

*(specialists in arc welding)*

A VIRGINIA manufacturer of underground gasoline storage tanks needed to cut his welding costs . . . his highly competitive industry being plagued with low profits.

Although they were already using the LINCOLN automatic submerged arc process, the LINCOLN Field Engineer was able to show this company how to eliminate 25% of their welding labor. He switched them to the new LINCOLN vapor shielded INNERSHIELD process.

Now the 4000-gallon tanks, fabricated from  $\frac{3}{8}$ " steel, are welded at 90 inches per minute . . . with three men doing the job formerly done by four. Thus, reduced labor costs have substantially increased the profit margin.

In addition, when this manufacturer licks a rolling and fit-up bottleneck, the three weldors will be able to almost double their present output with no additional help.

That's why we say it's a good idea to do business with LINCOLN where arc welding is a specialty and cost reduction comes to you as a "plus" at no charge.

THE LINCOLN ELECTRIC COMPANY

Dept. 2250 • Cleveland 17, Ohio

**LINCOLN**  
**WELDERS**

*All industry is talking about the new Van Norman*



Heavy duty Adjustable Cutterhead,  
standard on Nos. 16M, 24LA, 24MA,  
28A, 38MA and 38MEA Van Norman  
Milling Machines.

Cutaway view of Adjustable Cutterhead  
showing heavy duty construction.  
Spindle bearings are sealed and lubri-  
cated for life.



## **SYNTHANE CUTS** **VN Milling Machine**

Synthane Corporation, a leading manufacturer and fabricator of industrial plastics, wanted speed of production, versatility, and accuracy in a milling machine. They found them with Van Norman...as demonstrated when they ordered seven additional VN Milling Machines after they achieved such outstanding results with the first—production speeding results that paid off in cold cash for Synthane.

**VAN NORMAN**

SPRINGFIELD 7, MASSACHUSETTS

MACHINERY, November, 1960



## **THERMOSETTING PLASTIC MILLING TIME 25%**

**speeds output...holds tolerances...makes possible many production set-ups**

**Production Time Cut 25% to 30%**—With the new VN Milling Machine, Synthane has been able to cut production time 25% to 30%...an enormous cost factor. Moreover, the VN Milling Machine gives more varied production...is easily adaptable for a wide range of jobs. And gives more accurate, unsupervised production, too. Once set, VN Milling Machines can be run indefinitely on a particular job without rechecking...and

deliver the same precision and fine tolerance on the last piece milled as they did on the first.

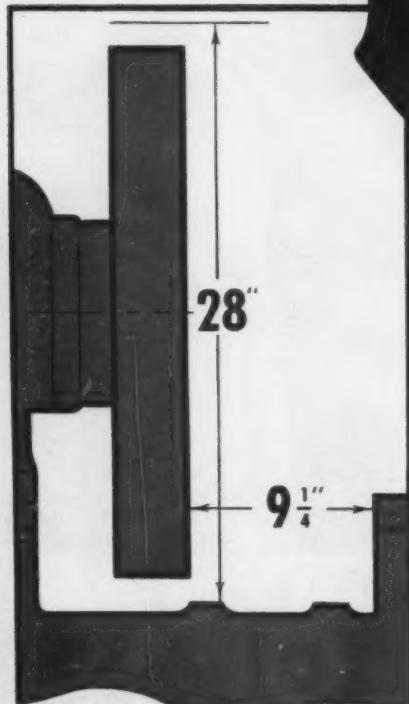
And Van Norman Milling Machines can deliver the same fine cost-saving results for you.

**Get Detailed Information**—Your local VN Franchised Distributor will be happy to show you how VN Milling Machines can cut your production time...and costs. For his name write direct to VN, Springfield, Mass.

**MACHINE COMPANY**  
A DIVISION OF VAN NORMAN INDUSTRIES, INCORPORATED



# BIG JOBS?



## CLAUSING GAP BED LATHES' EXTRA CAPACITY HANDLES THEM IN STRIDE!

You get the needed capacity to handle those BIG jobs simply by removing the bed segment of this Clausing 17" gap bed lathe. Note the swing in gap—28". And the length of gap in front of face plate—9 1/4". Here, for sure, is a heavy duty, precision lathe that handles your big diameter work . . . in stride! Now, check its other "BIG CAPACITY" features:

- 3 1/4" hole-thru-spindle.
- All-gearred headstock . . . shaved, hardened gears.
- Totally enclosed head and quick-change gear box, oil bath lubrication.
- Big L-2 taper spindle, hardened and ground.
- Large, Gamet tapered roller bearings with oil flow lubrication.
- Induction-hardened, precision ground bed ways.
- Separate rod for power feeds.
- Precision construction throughout to equal or surpass American standards of toolroom lathe accuracy. For example, each lathe is factory-checked to turn round within .0001".

Prices of the Clausing-Colchester 17" gap bed models, including 2-speed motor and Allen-Bradley controls, start at \$5100; 13" at \$2555 and 15" at \$3580. Straight bed and profiling models also available. Write for complete information today.

349

**CLAUSING**  
DIVISION OF  
**ATLAS PRESS COMPANY**

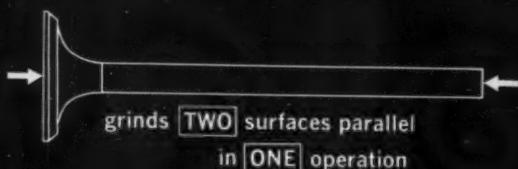
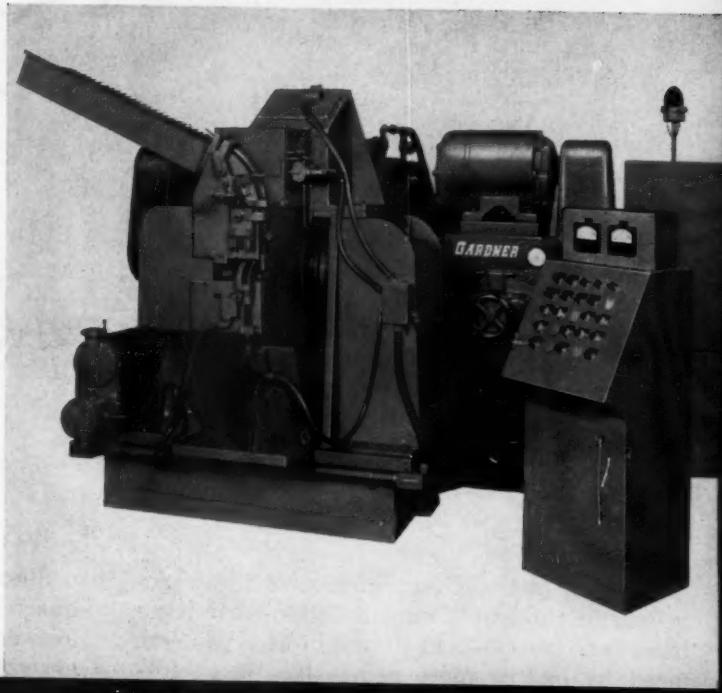
OUTSTANDING VALUES IN PRECISION MACHINES



11-110 N. PITCHER STREET, KALAMAZOO, MICHIGAN

# GRINDS 2200 VALVES PER HOUR

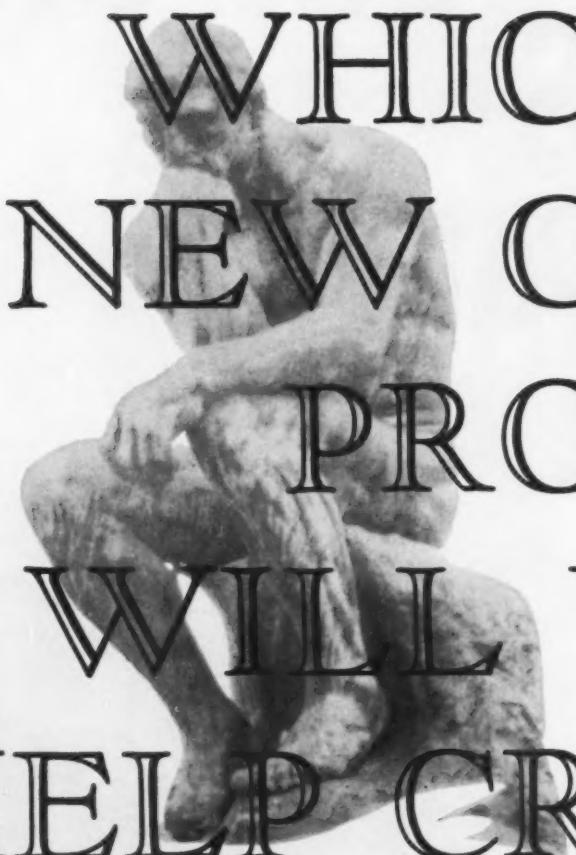
Gardner 2H30 disc grinder with automatic loading, grinding, sizing and unloading cycle.



#### production data

production:	2200 per hour at 100% efficiency
stock removal:	head end .006" max. stem end .007" max.
squareness:	head end TIR .003" stem end TIR .003"
uniformity:	TIR .002"
finish:	stem end 12 RMS

**GARDNER**  
precision disc grinders  
Beloit, Wisconsin



# WHICH NEW GEAR PROCESS WILL YOU HELP CREATE

Every new gear production process "we" pioneered in the last 3 or 4 decades—and there have been many—had its origin as a problem faced by one or more people like yourself—men who recognized the existence of a problem and came to Michigan Tool for the answer.

Lets go back to 1925 when automobile transmissions were so noisy that drivers couldn't hear themselves think over 30 miles an hour. Sales complained to management, management to engineering, engineering to manufacturing. They finally came to us and we put our engineers and research laboratory to work. You know the answer—gear shaving and the equipment that made quiet gears practical and economical.

Since those days, "Gear Production Headquarters" has poured out a steady stream of answers to the problems of men like yourself—answers like Shear-Speed gear shaping to make the cutting of toothed parts possible at high speeds; Roto-Flo cold rolling of all kinds of splines, threads and grooves in seconds instead of minutes—stronger and better than if machined; optical sine-line gear checking for either laboratory or on-the-floor control; Gear-O-Mation devices for automatic parts handling in process; double enveloping gearing to carry bigger loads with smaller gears; Ultra-Speed hobbing; hard gear finishing; giant shavers and hobs to turn out gears up to 20 feet in diameter to almost unbelievable precision toler-



## Michigan Tool Company



ances to make ship drives quiet to protect against submarines; grinding equipment to make even "spherical" gears.

To make some of the new processes work even better we created new tools, new coolants; new plastics for gear hones, indexing tables which divide a circle into 5 million parts accurate to a fraction of a second; even text and reference books to make gear designing easier.

You too must have a problem . . . large or small . . . about processes, machines or even tooling. Perhaps our experience has already provided the answer. If we don't have it, we'll go to work on it. Chances are we'll come up with it as we have so often before. It's worth trying and your Company will benefit.

7171 E. McNICHOLS ROAD • DETROIT • TW 1-3111

Plants in: Detroit, Traverse City and Manistee, Mich. and Windsor, Ontario.



**Gear Production:** The most complete line of equipment for gear production offered by any manufacturer.

Hobbers and Shapers for Job Lots  
High Production Hobbers  
Shear-Speed Gear Shapers  
Roto-Flo Cold Forming  
Shavers for gears of  $\frac{1}{2}$ " to 200"  
Internal and External Form Grinders  
Sine-Line Gear and Tool Checkers  
Gear Chamfering Equipment  
Abrasive Gear Finishers  
Mitco Quality Gear Cutting Tools

**Automation Equipment** (Gear-O-Mation Division): Engineering and manufacture of simple and practical equipment for automating a plant, a line, or a machine. Pre-engineered units for orienting, storage, loading, unloading, assembling, conveying, escapements, positioning, elevating, feeding.

**Form Grinding** (Gear Grinding Machines Division): "Detroit" fully automatic form grinders for both external and internal contours—involute, cycloidal, spherical, straight sided.

**Prototype Gearing** (Enterprise Division): Spur, helical, bevel gears and splines for prototypes and in developmental quantities. Also contour form grinding, internal and external.

**OTHER  
MICHIGAN TOOL DIVISIONS  
INCLUDE:**

Cone-Drive Gears Division (double-enveloping worm gears, speed reducers, gear motors); Michigan-Lorenz Division (hobbers and shapers); Shear-Speed Chemical Products Division (coolants and cutting oils); Colonial Tool Co. of Canada Ltd. (cutting tools of all types).

# 5 ALL-NEW BICKFORD DRILLING MACHINES

**Heavy-duty radials and uprights that feature horsepower to go with size, ease of control that helps the operator turn out work faster and at lower cost.**

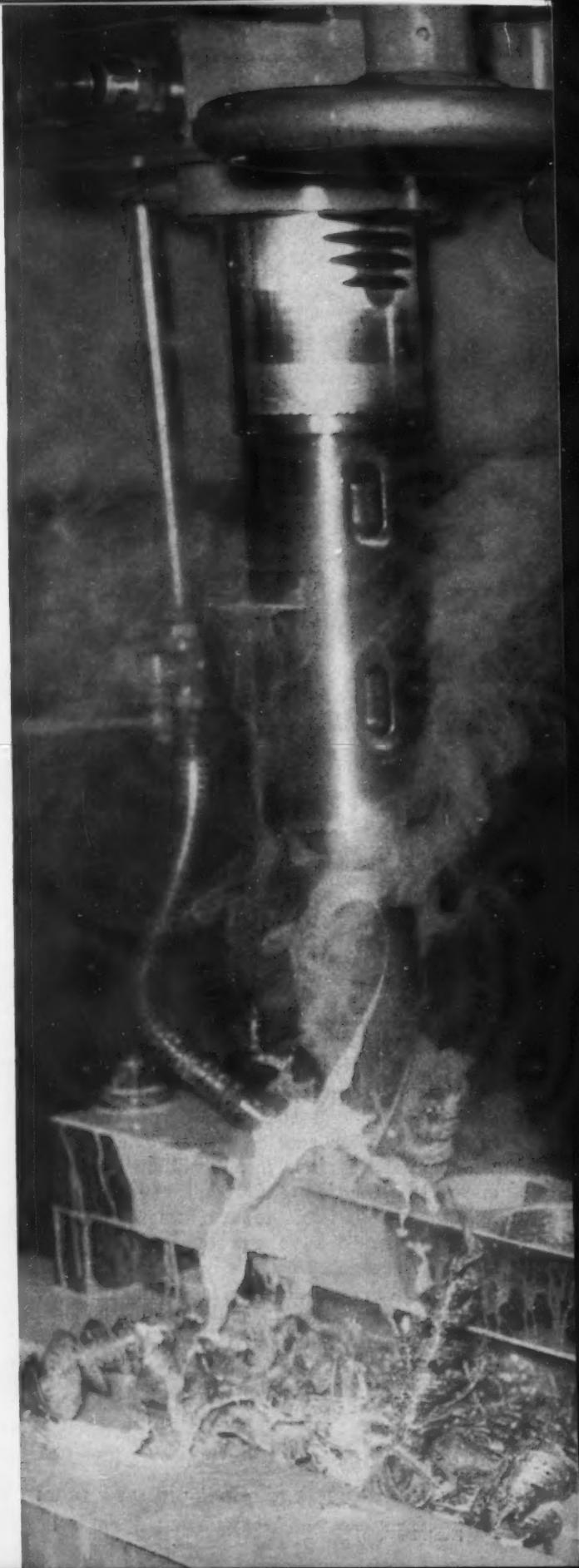
With the trend today toward faster, more automatic machine tools, Giddings & Lewis engineers took a long, hard look at drilling machines — and then went to work. The result is the most advanced new line of radials and uprights available anywhere.

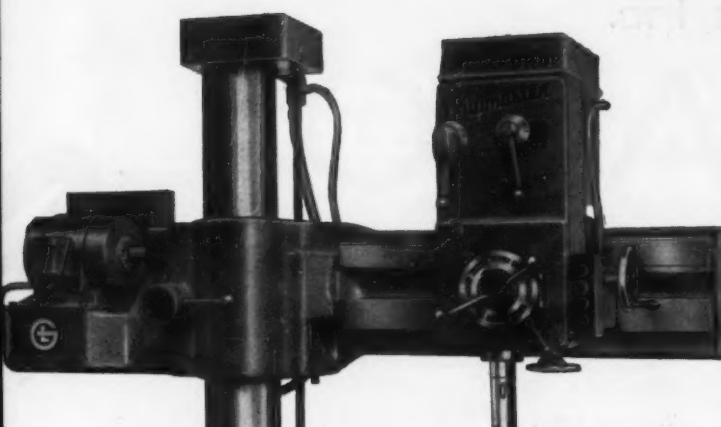
Production men no longer need to make allowances for production slow-ups in the drill department. The completely new Bickford heavy-duty drilling machines shown here incorporate a host of automatic features that establish new standards of accuracy, ease of operation, and reliability.

In terms of productivity, these new machines are by far your best investment, dollar for dollar, of any drilling machines now manufactured. Write for literature or call your Giddings & Lewis distributor.



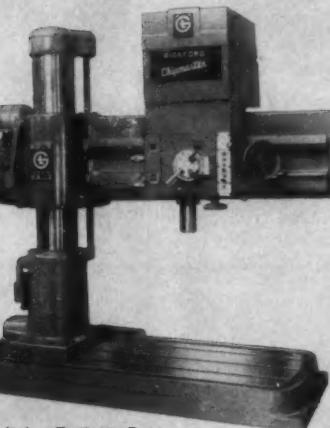
World's most complete line of heavy-duty drilling machines — radials to 34" . . . uprights to 39" . . . ultra-precision machines . . . portable and universal machines . . . 3 to 50 hp.



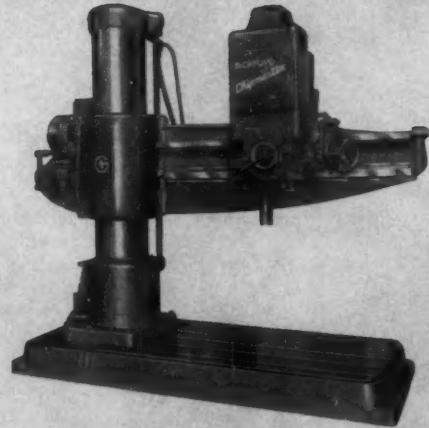


**9-inch Radial.** Automatic tapping reverse, centralized controls, short, stocky column with preloaded bearings, four-bearing spindle, 5-hp reversing drive motor. / **11-inch Radial** with extra-powerful head and pushbutton controls. Automatic tapping reverse, hydraulic spindle counterbalance, self-adjusting magnetic clutches, 9 power feeds, 12 speeds, 14" spindle travel. / **13 through 19-inch Radials.** Mechanical shift, partial or full preselect—36 speeds to 2300 rpm with quick reverse spindle, 18 feeds from .004" to .125". Three tap lead ranges. **28-inch Upright** — automatic single-cycle drilling and tapping. Drills to center of 29-1/2" workpiece. Cycle dwell control and fine feed wheel for counterboring, spotfacing. Pushbutton controls. **30-inch Upright.** Centralized controls, automatic electric tapping reverse, 12 speeds, 9 feeds, 10 hp. Electric thrust relief and dwell control for accurate depth machining.

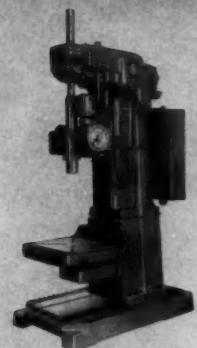
9" radial — Bulletin R-9



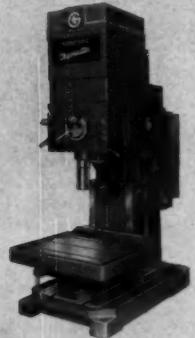
11" radial — Bulletin R-11



13" through 19" radials — Bulletin R-35



28" upright — Bulletin 3-CD



30" upright — Bulletin BU-30



# GIDDINGS & LEWIS

GIDDINGS & LEWIS MACHINE TOOL COMPANY, Fond du Lac, Wis.

Jig borer and milling machine; horizontal boring, drilling, and milling machines; vertical turret lathes; vertical boring mills; positioning tables; die sinking machines; contour milling machines; radial and upright drilling machines; planers; planer mills; numerical and tracer control systems; Davis boring tools.

**At Amana Refrigeration, Inc.**

# STANOIL

**Situation:** The 600 ton Verson Press at Amana is a vital operating component in the manufacture of home freezers and refrigerators. Its proper performance is necessary to the efficiency of Amana's entire manufacturing operation. That's why erratic press operation, caused by foaming of the hydraulic oil, was a serious problem.

**What was done?** In seeking the solution to this problem, Amana consulted their Standard Oil lubrication specialist who recommended STANOIL for this service. STANOIL Industrial Oil is a top quality, first-line industrial lubricating and hydraulic oil. It will provide excellent service in many different applications. And when tested by Amana, STANOIL proved perfect for use.

**What has happened?** Since STANOIL was first put to work at Amana, it has performed for extended periods of time without foaming or oxidation, lengthening the time between drainings and improving press operation. As a result of this record, STANOIL has been adopted for use on other production equipment, together with Standard's RYKON Greases and SUPERLA Soluble Oil.

**What you can do:** To get help in solving your lubrication problems and to learn more about STANOIL Industrial Oils, simply call the Standard Oil office near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**



Production manager Neal Stewart reviews Amana's maintenance expense reductions with Standard's Jess Nelson.



## **IMPROVES PRODUCTION REDUCES MAINTENANCE**

**Smooths operation of 600 ton hydraulic press**

You expect more from  and you get it!

### **Quick facts about STANOIL Industrial Oil**

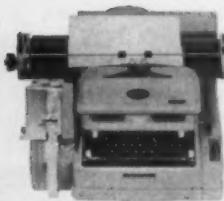
- Antioxidant gives oil resistance to chemical change, minimizes deposits.
- Inhibitor "plates out" on metal surfaces, prevents corrosion.
- Receives special refining to eliminate emulsion problems. Contains additive to minimize foaming.
- High viscosity index. Resists temperature change.

Standard's Jess Nelson (far left) and Gene Maske (back to camera) discuss performance of the Verson Press with Leonard Rettig, Amana's plant maintenance superintendent. Jess, who is District Engineer for Standard, is a specialist in this kind of operation. He has an engineering degree from the University of Iowa, and has also graduated from the Standard Oil Sales Engineering School.

# Is punched tape really the best input medium for numerical control?



(3 out of 4 machine tool makers say yes!)



Although 8-channel punched paper tape is only one of several numerical control input media, it is fast becoming the standard. Better than three-quarters of all builders of numerically-controlled machine tools now offer punched paper tape control. Why the swing to punched paper tape? There are three fundamental reasons:

- 1) Paper tape coding is visible, tangible. You can see it, touch it, and with practice even read it.

- 2) Paper tape is continuous. Unlike cards, it can't get out of order.
- 3) Paper tape is easy to program—preparation, verification, and reproduction of tapes are all handled on one inexpensive machine, the Friden Flexowriter® (illustrated).

For the machine tool buyer, standardization on paper tape means great savings. It's so much easier (and less expensive) when *one* input system can control *all* of the numerically-controlled machines in a given plant.

If you're thinking numerical control, you'll be way ahead to think *punched paper tape*.

© 1960, FRIDEN, INC.

FOR FURTHER INFORMATION WRITE TO FRIDEN, INC., SAN LEANDRO, CALIF.  
SALES, SERVICE AND INSTRUCTION THROUGHOUT THE U.S. AND THE WORLD



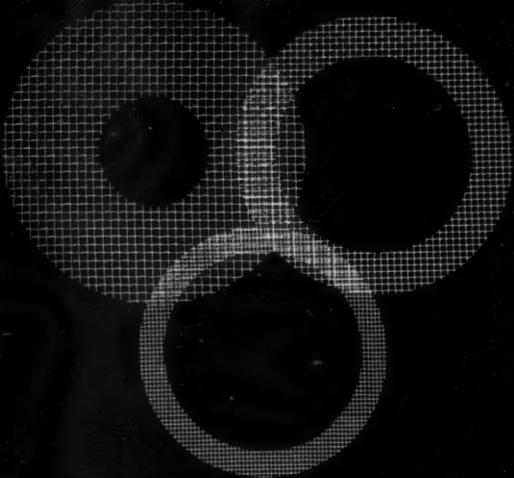
# Friden

MACHINERY, November, 1960

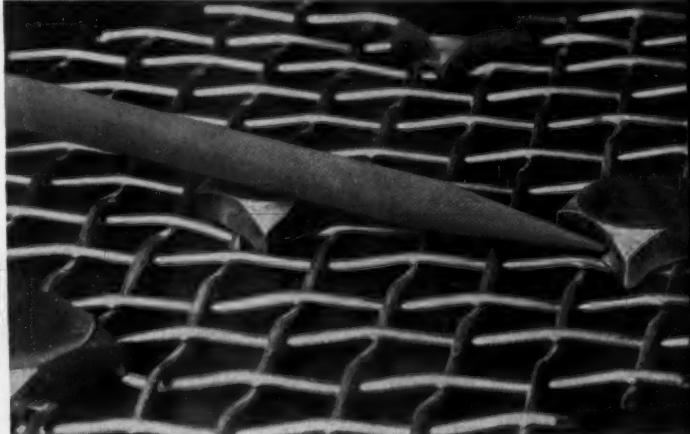
# DISC SAFETY AND ECONOMY

with  
**Gardner Wire-Lokt®**  
construction

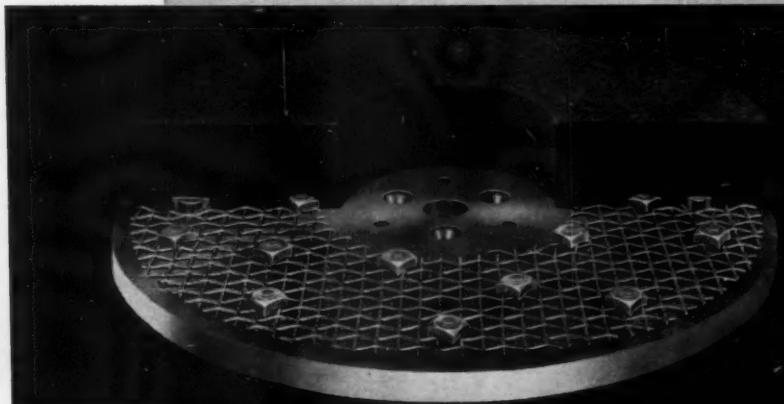
Full value is assured because  
usable abrasive extends right  
down to Wire-Lokt backing.



Heavy steel wire mesh becomes firmly embedded in the abrasive structure, actually forming a part of the abrasive backing.



Special steel anchoring nuts lock securely into wire mesh. In manufacture, abrasive is forced around and under steel mesh and nuts.

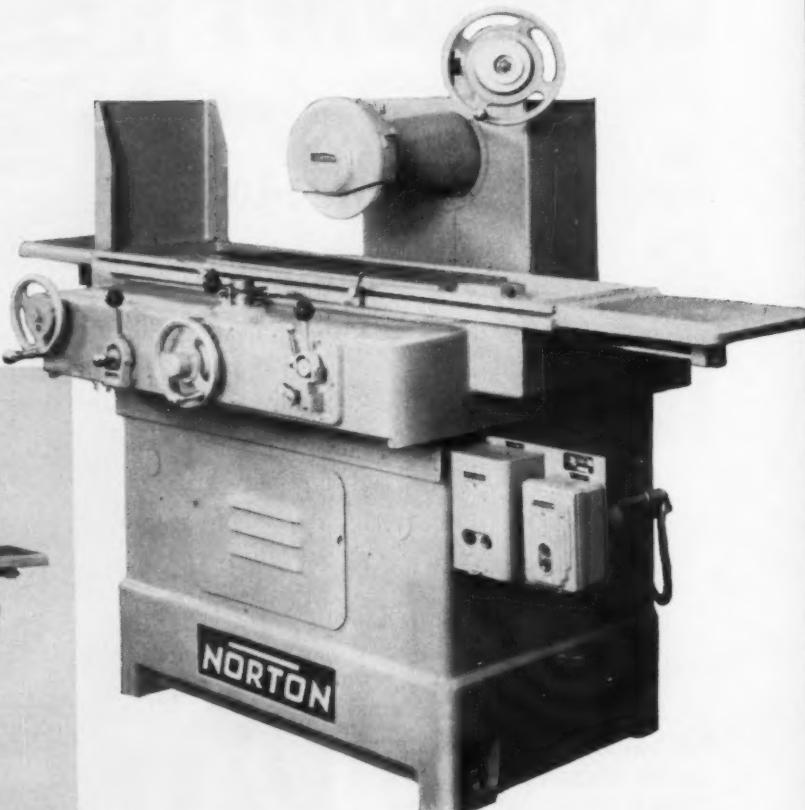


**GARDNER**  
abrasive discs  
ELGIN, ILLINOIS

# *Now...Type S-3 surface with 150 fpm table*

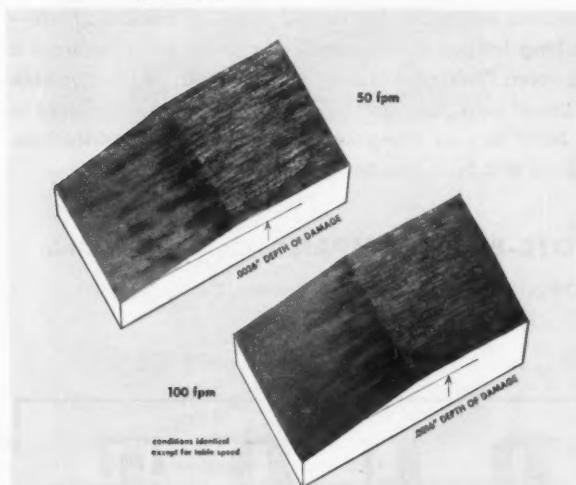
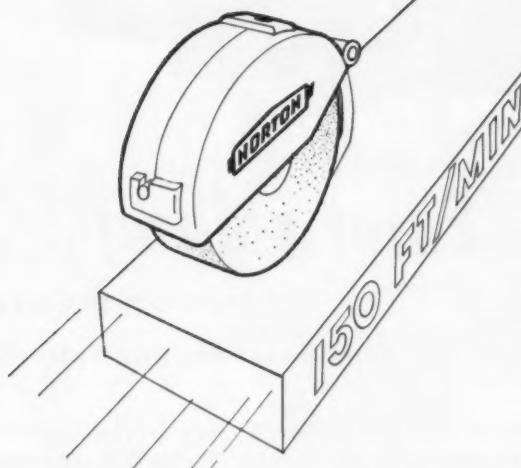
## *for faster production than ever before!*

Available in 6" x 18" and 8" x 24" sizes. Both sizes are equally fast, cool, accurate on long production runs or a wide variety of toolroom grinding. Taller workpieces are easily handled by the 15" vertical capacity of the 6" S-3, and 13 $\frac{3}{4}$ " capacity of the 8" S-3 Grinder. Other job-proved features include a two-speed .0001" increment hand wheel, assuring accurate vertical speed and fast positioning . . . contoured splash guards, for better sighting and loading.



NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure Sensitive Tapes

# grinders speed...



**You Get Better Quality Work** with Norton Type S-3 surface grinders, thanks to their faster table speeds, which reduce heat damage. The above test samples show how faster table speeds result in cooler grinding.

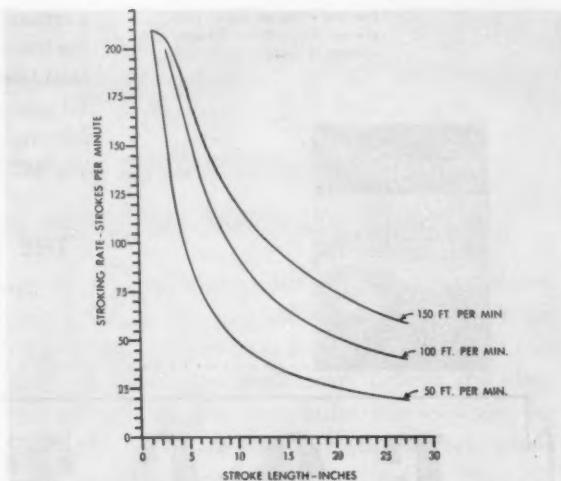
Long popular for their pace-setting table speeds up to 125 feet per minute, Norton Type S-3 surface grinders have given complete proof of their ability to finish workpieces smoother, faster, at lower cost.

*Now S-3 grinders are also available with table speed stepped up to a new high of 150 feet per minute — enabling you to finish flat faster than ever, with cool-running action that saves time and money on every job.*

Get the whole story from your Norton Man, a trained specialist who can help you get better grinds at lower cost. Or ask for Catalogs 1982 and 2128. NORTON COMPANY, Machine Tool Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. In Canada: J. H. Ryder Machinery Co. Ltd., Toronto 5.



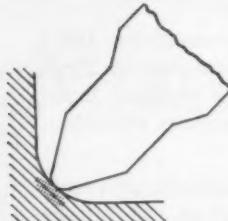
75 years of... Making better products  
...to make your products better



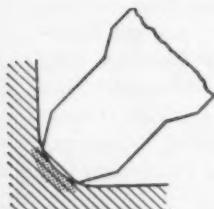
**Calculate Your Savings** from this production rate chart. Grinding time is reduced in proportion to the increase in stroking rate. The higher speeds also greatly increase the rate of stock removal.

## ENGINEERED FOR PRODUCTION

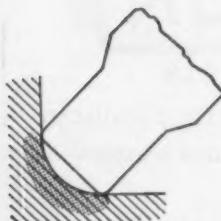
This is how  
fillet rolling works:



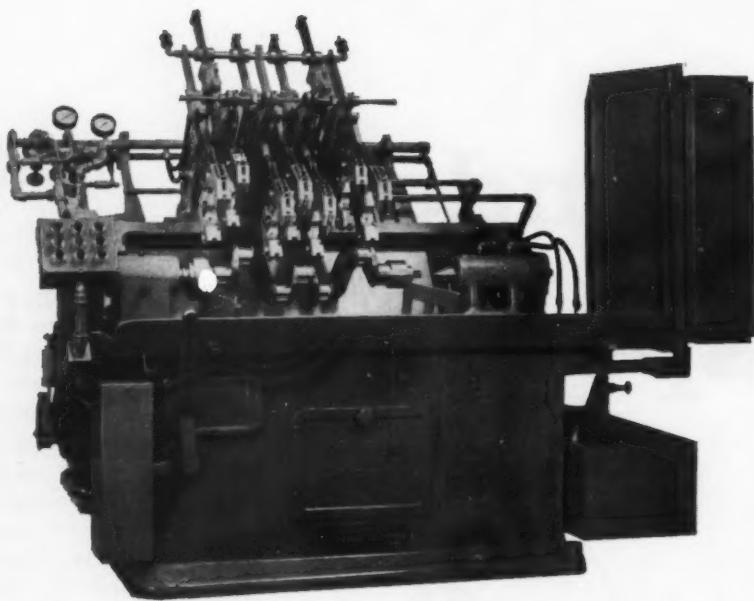
Two rollers under hydraulic pressure turn against each fillet as crankshaft is rotated.



As each roller turns, a V-track on its periphery expands outward across fillet surface.



Peening effect on metal compresses skin, creates compressive stresses that prevent fatigue failures.



## Fillet rolling . . .

low-cost process

eliminates fatigue failure

Fillet rolling is a scientific method of strengthening crankshafts against fatigue failure. Footbur-Schrader automatic fillet rolling machines produce controlled stresses at the critical points of the crankshaft—the fillets—cutting fatigue failure drastically at the points where it is most likely to occur. Production is high, and the machine is adjustable for various sizes of work. Our specialists have years of experience in fillet rolling. Send us your blueprints and production specifications. We will be glad to advise you on your needs.



THE FOOTE-BURT COMPANY, Cleveland 8, Ohio

Detroit Office: 24632 Northwestern Highway, Detroit 35, Mich.

..... Write for Circular 512

# FOOTBURT

LEADERS IN FILLET ROLLING

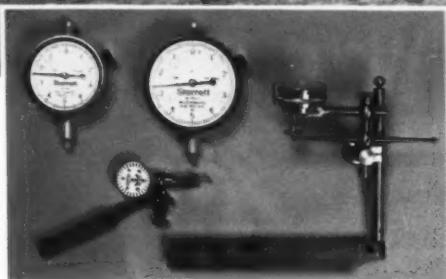
**Starrett® HIGH SPEED STEEL BAND**

RE-ORDER  
RS 1406-6

**Starrett®**

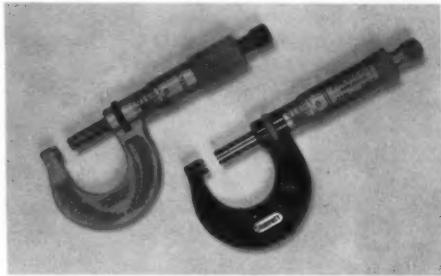
S-M HIGH SPEED  
**RED STRIPE®**  
HACKSAWS

**Starrett® ALLOY BAND**

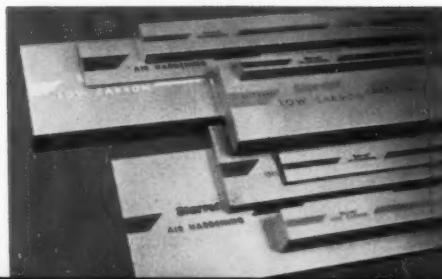


DIAL INDICATORS AND GAGES

PRECISION TOOLS



PRECISION GROUND DIE AND FLAT STOCK



HACKSAWS, HOLE SAWS, BAND SAWS, BAND KNIVES — Starrett ALLOY BAND Double Carbide and SAFE-FLEX® High Speed Steel Band Saw Blades, RED STRIPE® S-M High Speed Steel Hacksaw and SAFE-FLEX® High Speed Welded Edge Hole Saw.

**Starrett®**

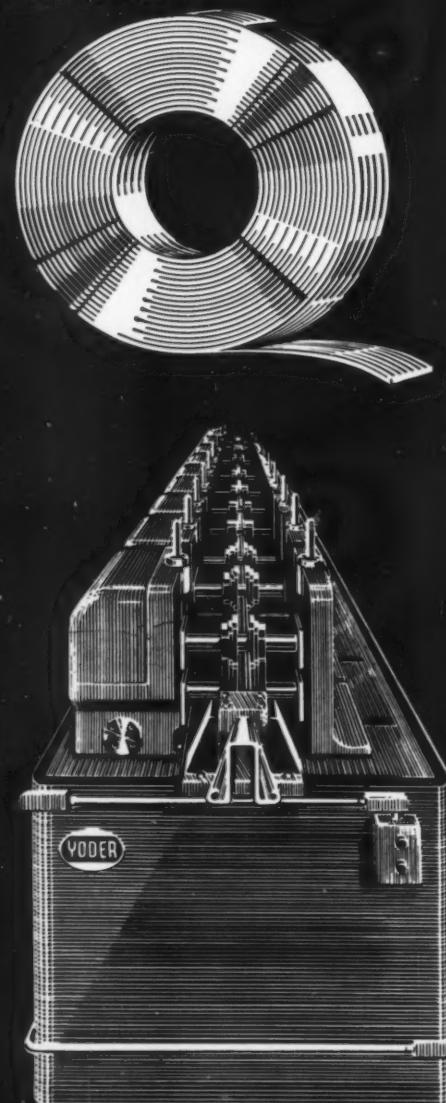
**toolmaking craftsmanship  
gives you better bands and blades**

From the modern, streamlined Starrett hacksaw and band saw plant comes a full line of precision-made band saws, band knives, hacksaws and hole saws. You can buy them with complete confidence through the same nearby Industrial Supply Distributor who sells you the many other fine products that carry the Starrett name. Write for complete Catalog No. 27. Address Dept. D, The L. S. Starrett Company, Athol, Mass., U.S.A.

*World's Greatest Toolmakers*



... from start



... to finish

COLD ROLL-FORMING EQUIPMENT

PIPE AND TUBE MILLS (ferrous or non-ferrous)  
ROTARY SLITTING LINES

## YODER ROLL-FORMING EQUIPMENT

Profits are available to you through the production of many shapes in metal... made with precision and economy on Yoder Cold Roll Forming Equipment.

Produce tubular, ornamental or structural shapes from a variety of metals in widths from a fraction of an inch up to 80 inches or more, and in stock up to  $\frac{3}{4}$ " thick. Your investment is comparatively modest, and with proven low operating costs, will give you one of the most profitable operations in your plant.

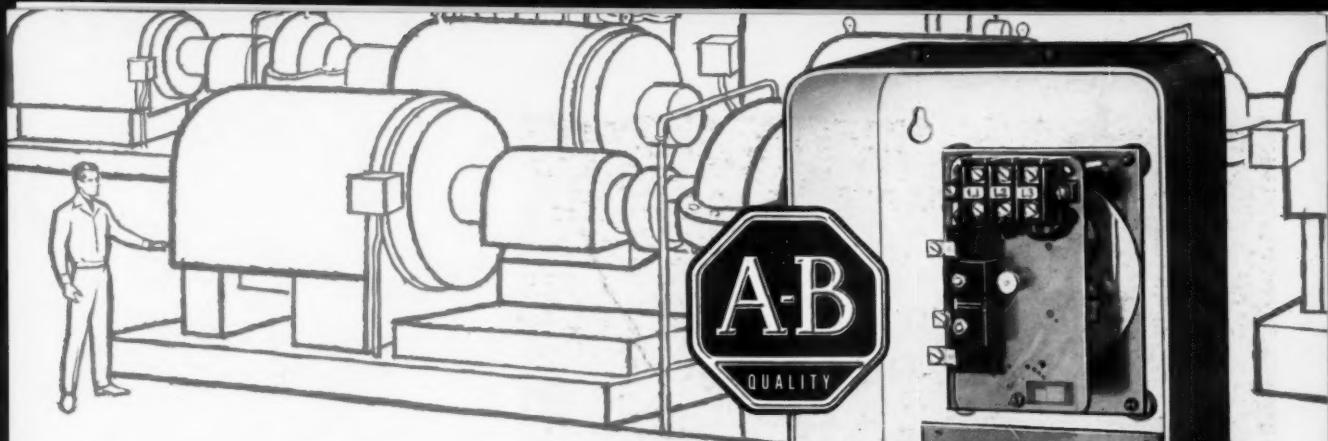
Experienced Yoder engineers will, without obligation, study your annual metal forming requirements. Many times they can point out that the installation of roll forming equipment would—even if operated only intermittently—soon justify its initial cost.

Send today for this comprehensive, 88-page illustrated text. It fully describes Cold Roll Forming Equipment, processes and products.



**THE YODER COMPANY**  
5504 Walworth Ave. • Cleveland 2, Ohio





# ALLEN-BRADLEY PHASE FAILURE and PHASE REVERSAL RELAYS

**will provide positive protection for high-horsepower, high-priced motors!**

It's sound "economy" to guard your investment in expensive motors and equipment against the extensive damage that can result from a phase failure or phase reversal. Allen-Bradley's Bulletin 812 Style RF relay provides complete, positive protection against both of these hazards.

The **Bulletin 812 Style F phase failure relay** instantly detects all open phase conditions on a motor branch circuit and removes the motor from the line—yet is not subject to nuisance dropouts from transient line fluctuations. An unusual feature of this Style F relay is its positive response, regardless of motor load or type of motor branch circuit employed.

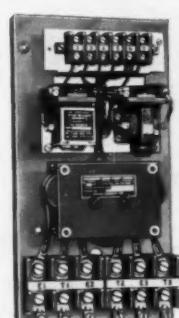
The **Bulletin 812 Style R phase reversal relay** disconnects the motor from the line—whether it is running or not—when a phase reversal occurs on the line side of the relay. Thus, it can be used to protect a single motor or a group of motors. Furthermore, the Style R relay removes the motor from the line should a phase failure occur while the motor is stopped.

All A-B Bulletin 812 relays are completely "fail safe." It will pay you to investigate this economical insurance against the heavy losses that can—and frequently do—result from phase failure and phase reversal. Write today!

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.  
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



Bulletin 812 Style RF for Phase Failure and Phase Reversal consists of Style F Phase Failure and Style R Phase Reversal relays in the same enclosure.



Bulletin 812 Style F for Phase Failure



Bulletin 812 Style R for Phase Reversal



# ALLEN-BRADLEY

Member of NEMA

**Quality  
Motor  
Control**



**NOTICE!**

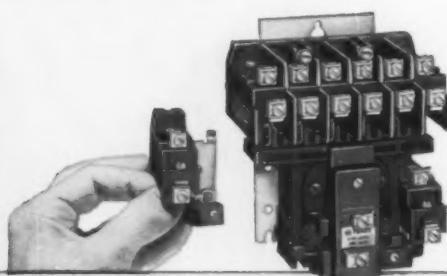
# 60 Second Contact Convertibility

## ALLEN-BRADLEY CONTROL RELAYS

can thus easily be changed  
from N.O. to N.C. (or vice versa)

Why not give yourself a real surprise! We refer to the ease with which you can convert the contacts of these Allen-Bradley Bulletin 700 Type BR control relays. Using only a screwdriver, contacts can be changed from normally open to normally closed (or vice versa) in seconds—without removing the relay from its mounting—or its wiring. This "on-the-spot" convertibility certainly suggests an appreciable moneysaving reduction in your relay inventories.

Extensive tests have proven conclusively that the Bulletin 700 Type BR relays are good for many—and we mean *many*—millions of trouble free operations. A "built-in" permanent air gap completely eliminates all possibility of magnetic sticking. Naturally, the double break, silver contacts never need attention. Also, the molded coil is your assurance that even the most severe atmospheric conditions cannot cause trouble. Please write for full details on these relays today!



### BUT HEAR THIS!

In the event that when "on-the-job" it is discovered that something was either overlooked or added, the standard Bulletin 700 Type BR—either 2, 3, 4, or 6 pole relay—can easily have added to its base, out in the field, either one or two switching poles. It is done as easily as "falling off a log."



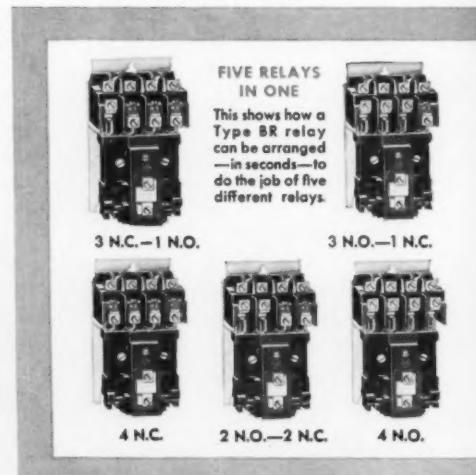
General-Purpose  
NEMA 1



Explosion-proof  
NEMA 7



Waterproof  
NEMA 4



# ALLEN-BRADLEY

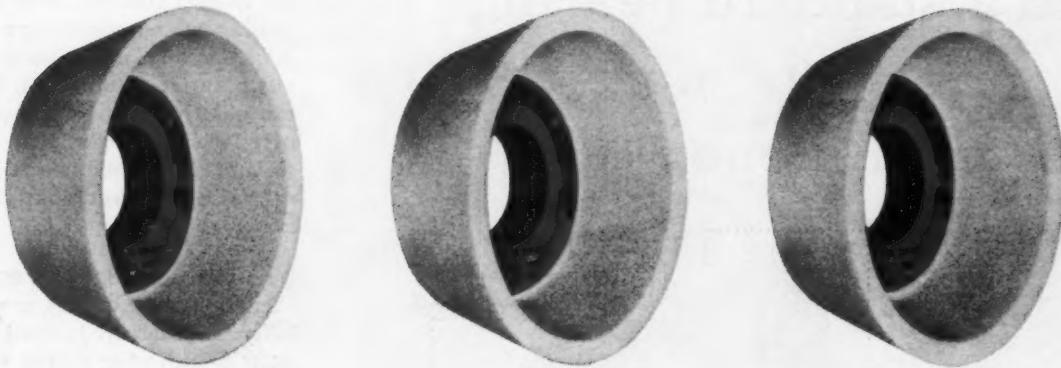
Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

**QUALITY  
MOTOR  
CONTROL**



## POSITIVE DUPLICATION - EVERY TIME!



You can depend on a rubber stamp to print identical information time after time after time. You can also depend on the Positive Duplication of these toolroom cup  $\ominus$ -wheels—and all CINCINNATI  $\ominus$  GRINDING WHEELS.

### HERE'S HOW (PD) IS ACHIEVED

To supply you with wheels of uniform excellence, Cincinnati's unique  $\ominus$  manufacturing process is unvaryingly regulated by 36 separate quality controls. For example . . . Humidity and temperature of the Wheel Mold Room are kept at the same levels every day throughout the year—an essential safeguard of  $\ominus$  uniformity.

### RESULT: DEPENDABLE PERFORMANCE

Each  $\ominus$  reorder wheel gives you exactly the same good job as the original. Production goes up and

stays up. Costs go down and stay down. This is the promise and performance—of Positive Duplication.

### CALL CINCINNATI TODAY

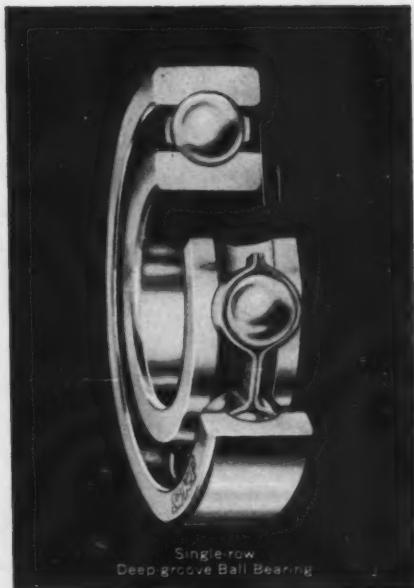
Solve your grinding problems with the help of Cincinnati's factory-trained specialists. Their wide experience in job set-ups and grinding operations is at your service. Just call your CINCINNATI  $\ominus$  GRINDING WHEEL Distributor, or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.



POSITIVE DUPLICATION

**CINCINNATI**  
GRINDING WHEELS

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.



## Can a standard bearing offer you "more bearing" for your money?



It can if it's made by **SKF**—because all **SKF** bearings, both ball and roller, offer special qualities at "production" bearing prices.

Take the single-row deep-groove ball bearing featured here, as an example. **SKF** designs and builds this type to sustain heavy radial load and thrust load in either direction. Furthermore, it is engineered to run smoothly and quietly at normal speeds with grease lubrication—and at high speeds with oil.

Yet this is a standard **SKF** ball bearing, mass-produced by automated production equipment at our plant at Altoona, Pa. You can quickly get this bearing in over 100 sizes, ranging from  $\frac{5}{8}$ " to 15.748" O.D., and in a variety of seal, shield and snap-ring combinations.

But why not find out what **SKF** offers in bearing quality, availability and economy? Just call the **SKF** branch office nearest you.





**The way Pipe Machinery's  
Correlchek Inspects NPT, ANPT, NPTF  
and NGT Threads**

Here's an amazingly fast, accurate method for checking the pitch diameter, crest truncation and root truncation of precision pipe threads (internal and external).

You simply set the instrument with master gages using your present gage members — then presto — check your fitting to the proper tolerances indicated by color zones on the dial. There's nothing to remember — nothing to figure out. The Correlchek does all your thinking for you . . . completely eliminates any chance for human error!

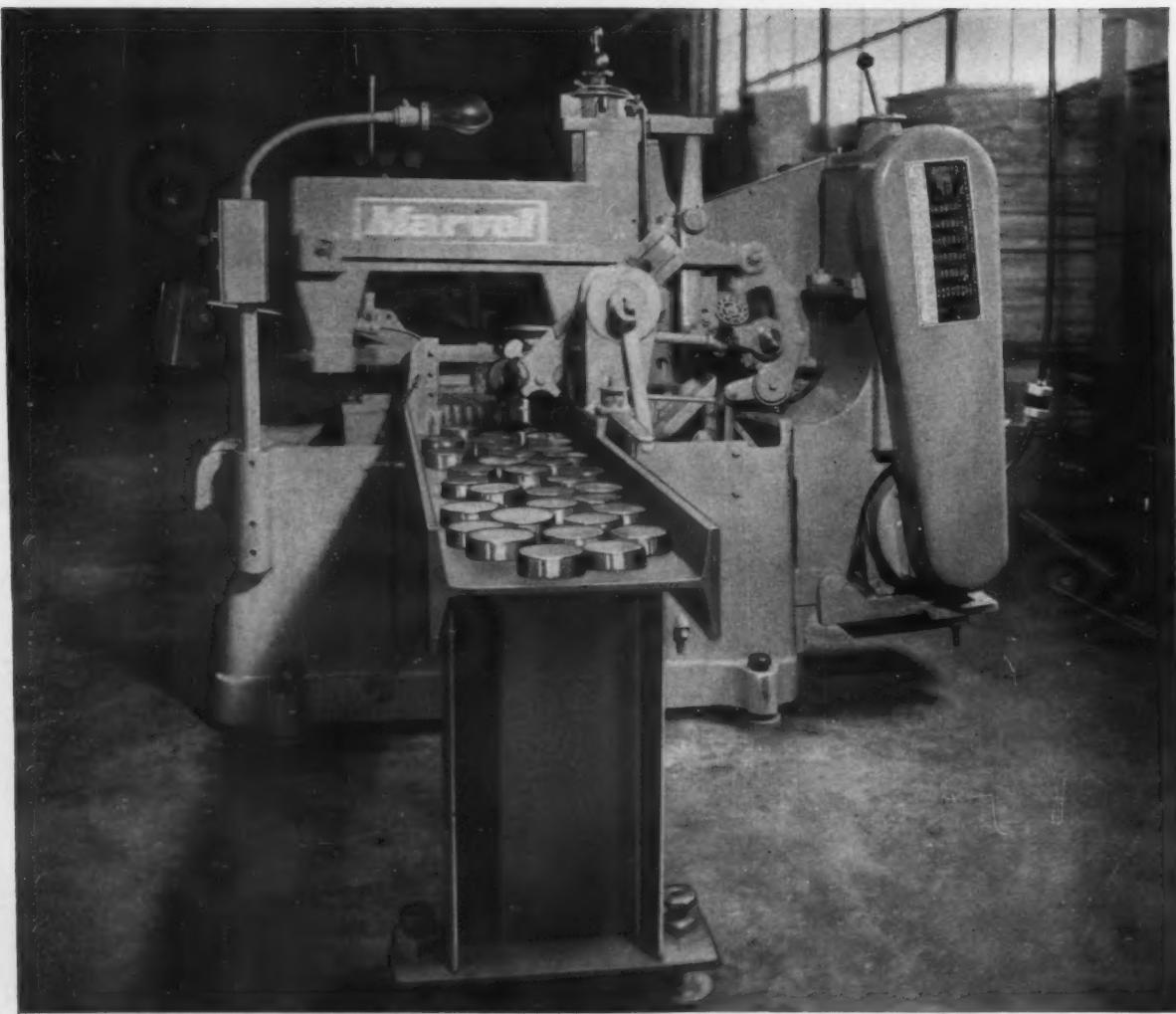
For more detailed information on this wonder working Pipe Machinery gage, write us on your company letterhead today.

**THE PIPE MACHINERY COMPANY** 29100 Lakeland Boulevard • Wickliffe, Ohio • Greater Cleveland  
MACHINERY, November, 1960

For more data circle this page number on card at back of book

39





## Payoff End of a Production Marvel

A cut-off saw's value is proven at the discharge end of the machine. How quickly the trough is filled with accurately cut-off pieces can mean the difference between profit and loss on many jobs.

The R. J. Sudrick Co., Des Plaines, Illinois, manufacturers of precision aircraft components had to cut-off 4600 blanks from  $3\frac{1}{4}$ " round, 303 Stainless Steel Bars.

They bought our MARVEL No. 6A4 High Speed Heavy Duty Automatic Bar Feed Hack Saw Machine; used MARVEL High-Speed-Edge Hack Saw Blades, and got the high production, accuracy and economy they desired.

**PRODUCTION?** Constant at 20 pieces per hour floor to floor

**ACCURACY?** Held well within the permissible tolerance of  $+.010 - .000$

**BLADE COST?** Just  $1\frac{1}{2}$ ¢ per cut. Only twenty-three MARVEL blades were needed to make the 4600 cuts, and not a single blade failure due to blade breakage. MARVEL High-Speed-Edge Blades are unbreakable.

**The point is this:** MARVEL Metal Cutting Hack Saws equipped with MARVEL High-Speed-Edge Hack Saw Blades are an unbeatable combination for economical, accurate and safe cutting-off.

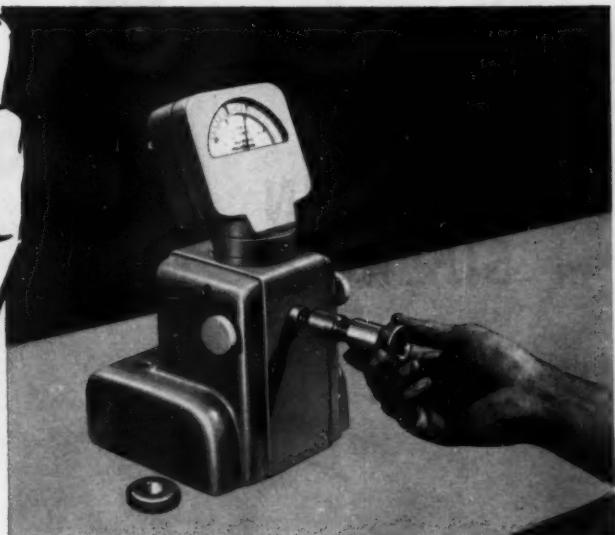
If your hack saws are not producing the economy you need to meet today's competition, try MARVEL High-Speed-Edge Blades. They will give you the competitive edge every time. Write for Catalog C-85 which has the complete story on MARVEL Hack Saws and Band Saws, Hack Saw Blades and Band Saw Blades.

### ARMSTRONG-BLUM MFG. CO.

5700 W. BLOOMINGDALE AVE., CHICAGO 39, ILL.

**MARVEL** Metal Cutting  
**SAWS** Better Machines-Better Blades

# NOW—Two dimensions in one setting ring gage!



A single Bryant 2-D Gage replaces two master setting ring gages, keeps air gages accurate!

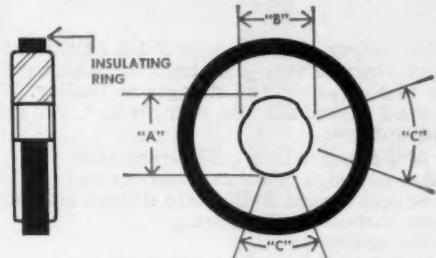
## Check the advantages of the new Bryant 2-D Master Setting Ring Gage

- Fastest, easiest calibration method
- Detects any change in range
- Controls high or low indicator drift
- Checks pneumatic plug wear
- Cuts master ring inventory in half
- Fast delivery of standard or special sizes

The revolutionary Bryant 2-D Precision Master Setting Ring Gage combines maximum and minimum setting dimensions in one air gage calibrating ring! Measured and marked to Class X accuracy, 2-D Master Rings can be used to calibrate any spindle-type air gage. Standard sizes from .365" to 2.510" I.D.

Call today, or write direct for details.

## TWO STEPS TO ACCURACY!



1. Slide 2-D Master Ring over pneumatic plug with either "A" (Maximum) or "B" (Minimum) diameter oriented over plug nozzle. Adjust dial indicator of gage to corresponding minimum or maximum limit on scale.

2. Rotate Bryant 2-D Master Ring to its second diameter. Repeat gage calibration at opposite end of scale.

Surface finish within 40° working areas "C" is 4 micro-inch (RMS) or better.

### EX-CELL-O FOR PRECISION

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS  
• DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • RAILROAD PINS AND BUSHINGS • DAIRY AND OTHER PACKAGING EQUIPMENT

### EX-CELL-O

CORPORATION Greenville Plant, 945 E. Sater St., Greenville, Ohio

# BUILD IN STRENGTH AND LIGHT WEIGHT WITH **N-A-X** **FINEGRAIN STEEL**

In a wide variety of applications N-A-X FINEGRAIN—a low-alloy high-strength steel—can bring important weight savings without sacrifice of strength and safety. When you design N-A-X FINEGRAIN into your product, you get all these advantages:

- It is 50% stronger than mild carbon steel.
- Polishes to a high luster at minimum cost.
- Can be cold formed readily into difficult stampings without surface disturbances.
- Is stable against aging.
- Has high fatigue life with great toughness.
- Has greater resistance to wear and abrasion.
- Is readily welded by any process.
- Offers greater paint adhesion.
- Has twice the resistance of carbon structural steel to normal atmospheric corrosion.\*

\*Where greater resistance to extreme atmospheric corrosion is important, our N-A-X HIGH-TENSILE is recommended.

Sound like something for you? A thoroughly competent metallurgical service organization is available to work with you on any application problem you may have. Write, wire or phone Product Development Department, Great Lakes Steel Corporation, Detroit 29, Michigan.



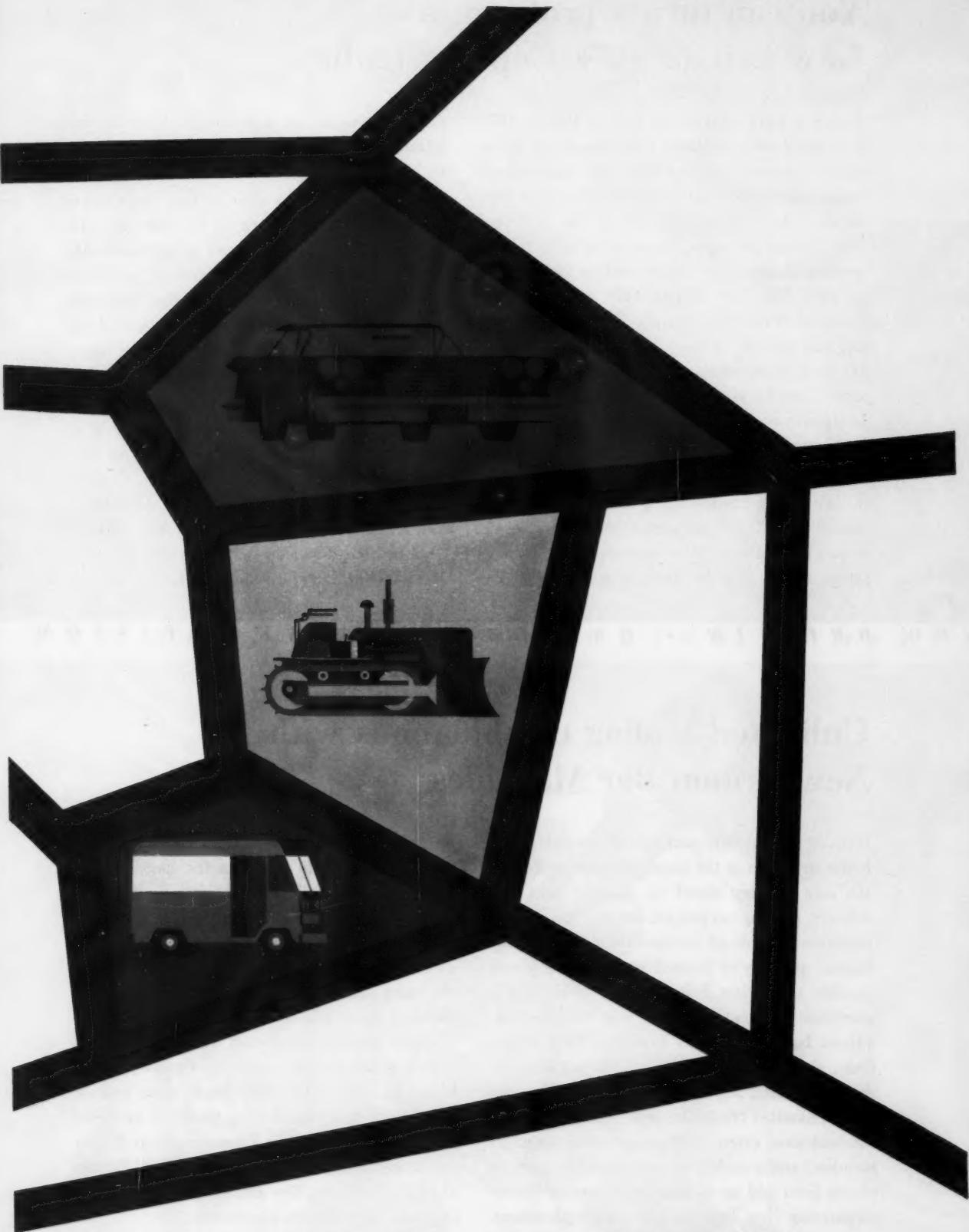
A PRODUCT OF

**GREAT LAKES STEEL**

Detroit 29, Michigan



Look for the STEELMARK  
on the products you buy; place  
it on the products you sell.



Great Lakes Steel is a Division of **NATIONAL STEEL CORPORATION**

## You can turn a profit on a New Britain +GF+ Copying Lathe

Here's a birdseye view of a New Britain +GF+ Copying Lathe. It shows some important differences between this machine and conventional lathes with copying attachments. The point here is this—*the most effective use of the single-tool copy-turning principle can be made only with a machine designed from the ground up for this type of work.* The New Britain +GF+ is just such a machine. Notice the chip pan. It's big (it has to be) and located for easy removal of chips from the back of the machine. The design of the work area allows for unobstructed free-fall of chips out of the way and into the pan.

The New Britain +GF+ is massive and rugged, with plenty of power—up to 40 h.p., if you need it. It's simple to operate, quick to set up and change over. The single-point tool can be changed in one minute and it out-produces gang tooling setups in the bargain. Turning is controlled by

either a template or a prototype. External and internal copying are accomplished in one set-up with special tooling.

The possibilities for short or long run chucked and between centers work on the +GF+ are wide and varied. Because the work is produced with good surface finish and dimensional accuracy, grinding can be reduced and, in some instances, eliminated. Large diameters are broken down economically by successive parallel cuts, automatically if desired, with optional two-cut or multi-cut recycling.

You've got to see one of these machines in action to fully understand the kind and quantity of work they are capable of producing. Contact your New Britain Representative for demonstration arrangements or write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

**NEW BRITAIN - GRIDLEY MACHINE DIVISION**

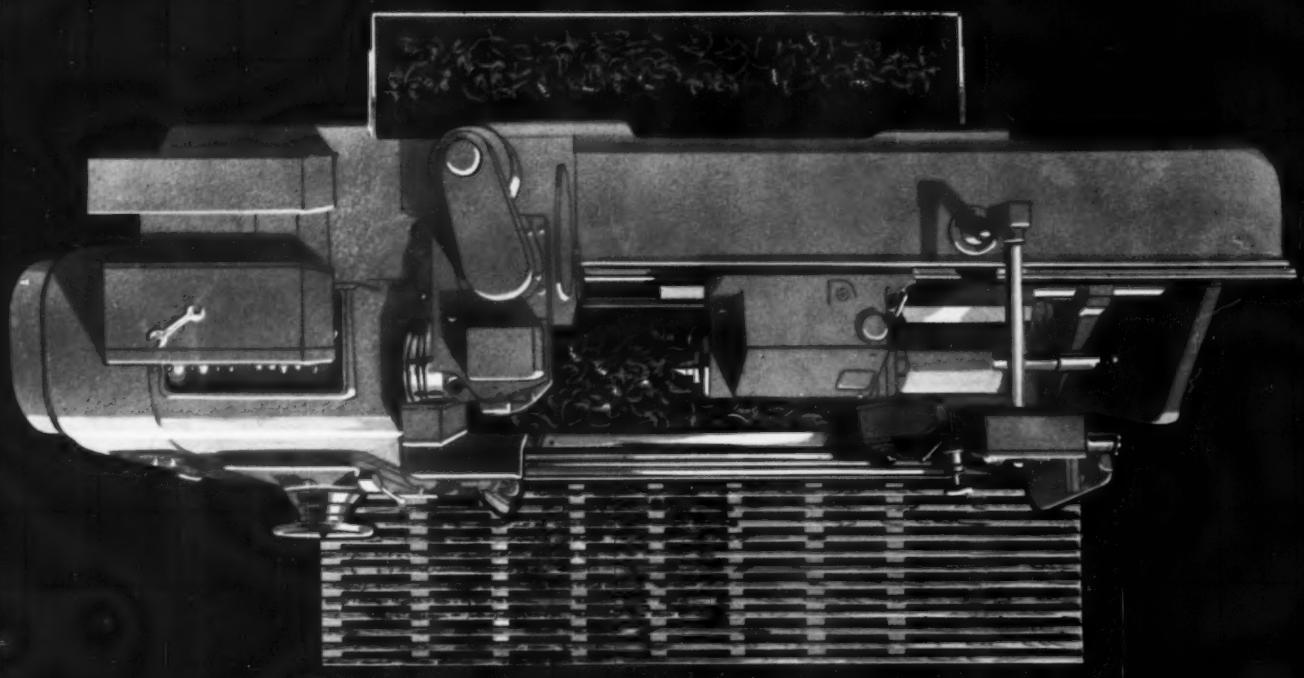
## Unlimited tooling combinations with New Britain Bar Machines

Nothing can out-date your operation quicker than better machines in the hands of a competitor. In the race to keep ahead on quality, price and delivery, nothing can put you out front faster than machines capable of consistently producing the highest quantity of finished pieces at the lowest possible cost. New Britain's new series of bar machines represents in every way the most advanced bar-turning units available. Each of the four-, six- and eight-spindle models has been redesigned, adding new features and improving older ones. Unlimited cross slide and end-working tool combinations, extremely fast operation (even on stainless) and a variety of models and features to choose from add up to some good reasons for incorporating New Britains into your replacement

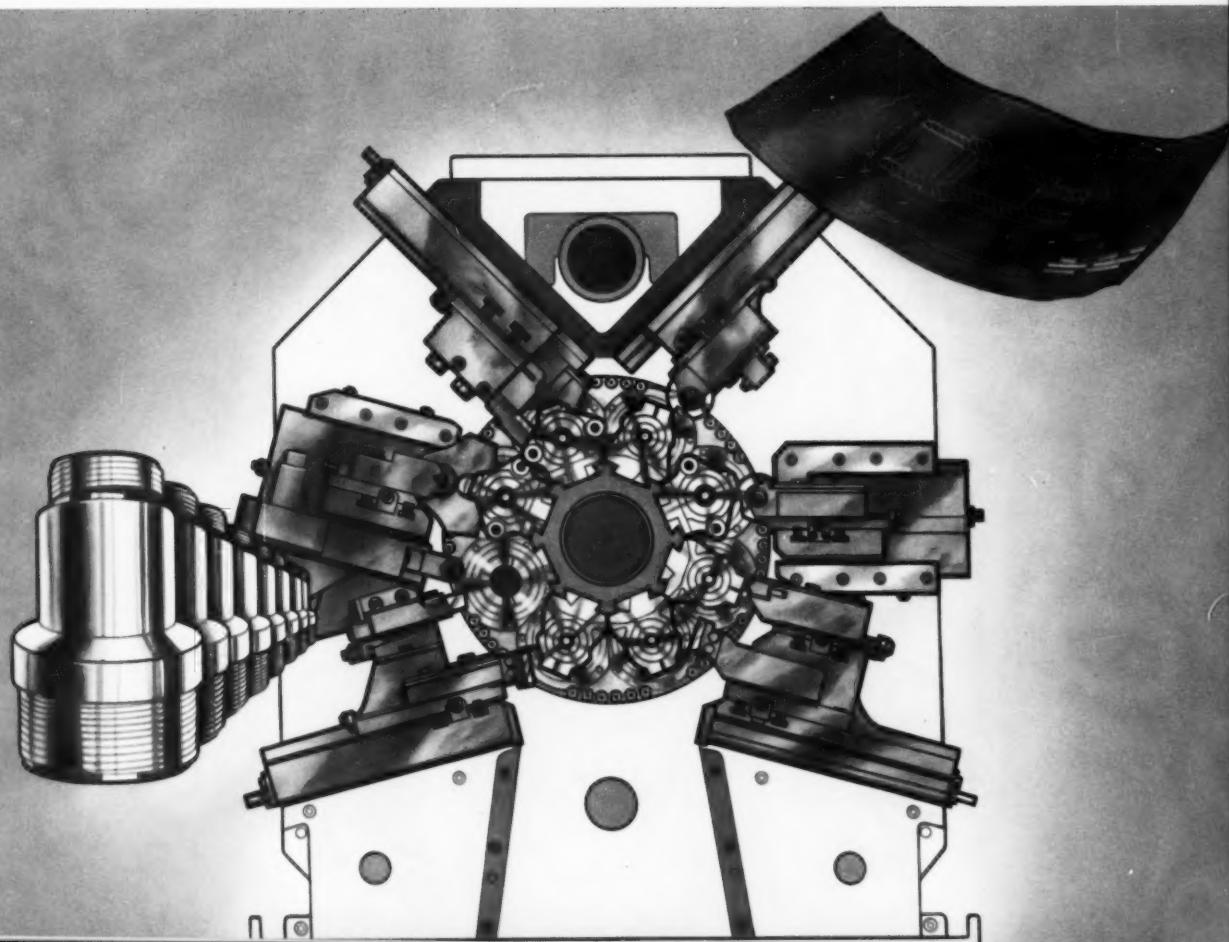
or production expansion plans.

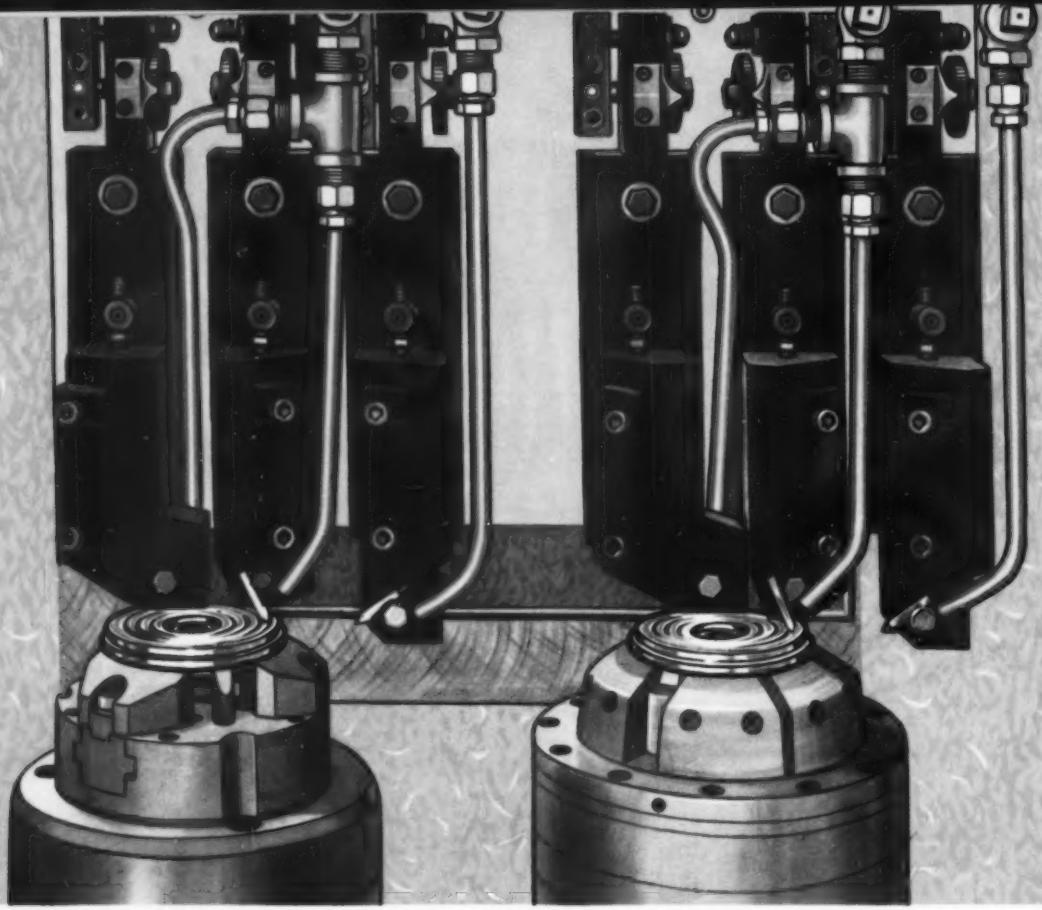
The eight-spindle model is the largest, most modern eight-spindle bar machine available. It has a stock capacity of up to 2 $\frac{5}{8}$ " and provides six independently-operated cross slides. As with all New Britain bar machines, the operations of the cross slides and end-working tool slide are disc-cam controlled for positive actuation, close tolerance machining and easy, rapid change-overs.

This is only a very small part of a story that is bound to interest you. The whole story and its significance in terms of your profits is available from your New Britain Representative. If you prefer, contact us directly at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

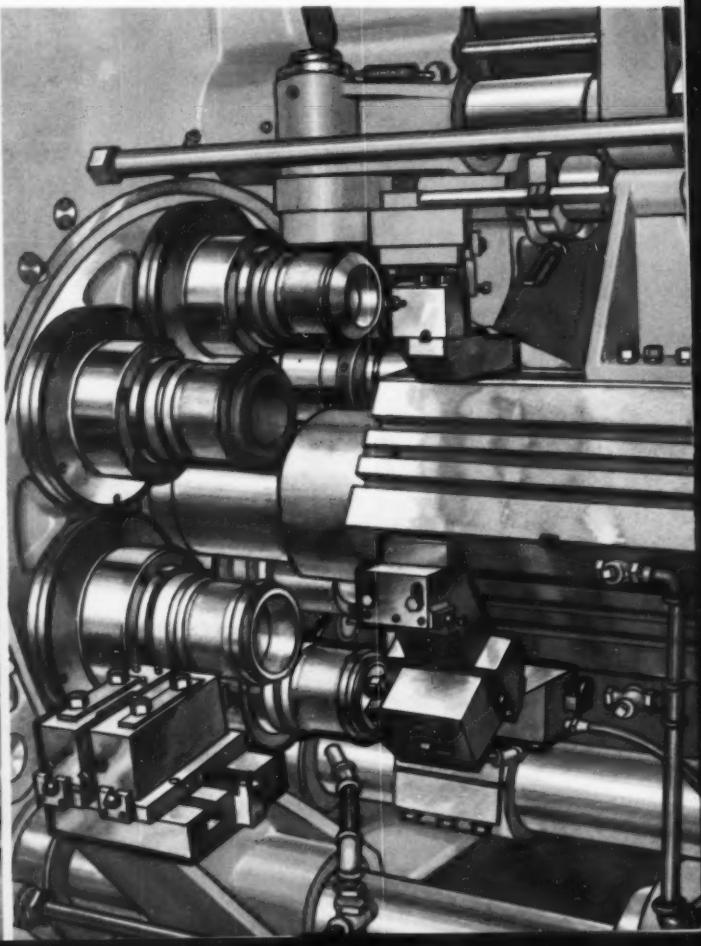
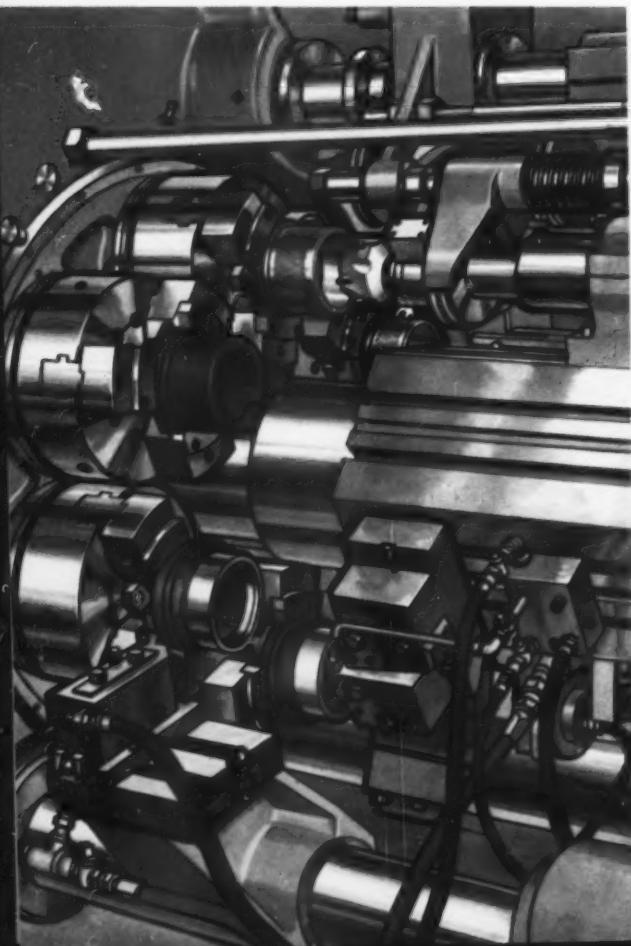


T H E   N E W   B R I T A I N   M A C H I N E   C O M P A N Y





NEW BRITAIN - GRIDLEY MACHINE DIVISION



## New Britain's new concept for contour turning and boring

Beyond a certain point, continued refinement of existing designs in machine tools ceases to make an appreciable contribution to performance. Thus in designing our New Series of Vertical Precision Boring Machines, we have incorporated several completely new design concepts to provide improved performance and greatly increase over-all usefulness.

For the first time machines of this type can be used as building block units. Their clean-sided design permits any number of self-contained machines, each with one or more spindles, to be arranged side by side and operated as a single unit. They also may be operated with equal efficiency as individual machines. Parts can be inverted on adjacent machines or on adjacent spindles of the same machine.

In order to take the fullest advantage of the

precision inherent in cam control, long linkages between cams and slides have been eliminated. A pair of cams is mounted on a common shaft which is carried *within the vertical slide*. Since all slide actuating forces are contained in the vertical slide, both cams are directly adjacent to the slides they control and no outside forces are imposed on the slide ways. The result is maximum rigidity for heavy cuts coupled with extreme accuracy for close tolerance work.

This unique and eminently workable approach to contour turning and boring results in the highest order of accuracy on even the most complex pieces. Your New Britain Representative can give you details on the nine different models available in this series. For catalog material, write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Conn.

**T H E   N E W   B R I T A I N   M A C H I N E   C O M P A N Y**

## New Britain... still the best Chuckers you can buy

We're not unhappy about the fact that for years, in many plants, the name New Britain has been synonymous with chuckers. New Britain Chuckers have turned out literally millions of pieces of work for practically every major industry in the world. This is less important to the prospective buyer of one of these machines, however, than the capabilities of these machines today. How do they stack up against other chuckers or even other types of machines capable of doing similar work? Pretty well, we think.

New Britain's open-end design still can't be beat for unlimited accessibility to the tooling area. This same wide-open feature makes it doubly more practical to adapt these machines to automatic loading and unloading.

The unusual combination of longitudinal and transverse forming motions is another unbeatable New Britain feature. The massive forming arms

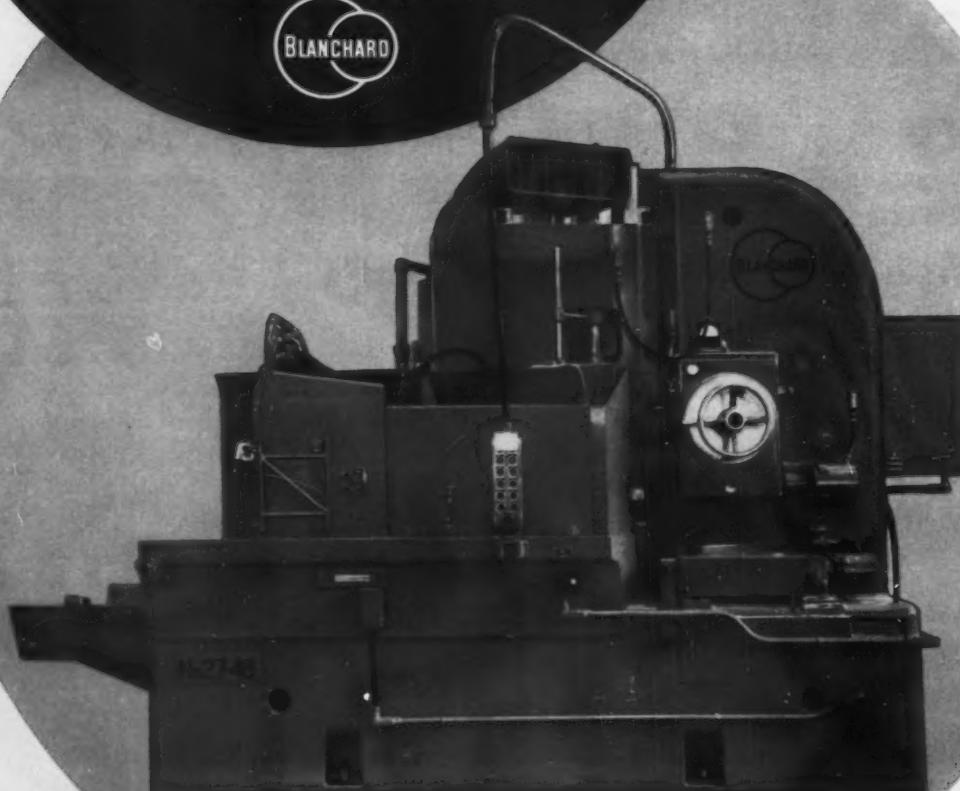
on New Britain Chuckers allow heavier cuts and cuts of much greater complexity. This ability to do more work can eliminate the need for second operation machines in many instances. For really complex work, two chuckers set up side by side, as shown here, each doing one side of the piece, can smooth the way for high production. Less complicated work can be set up to perform both sides of the same piece on a single machine.

These massive machines provide the tooling combinations, spindle speeds and power to perform the widest possible variety of work. Their basic design will stay new for years to come, continuing to provide profitable operation. You may know New Britain Chuckers, but you may not be fully aware of the improved series presently being offered. Why not call your New Britain Representative or contact us at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

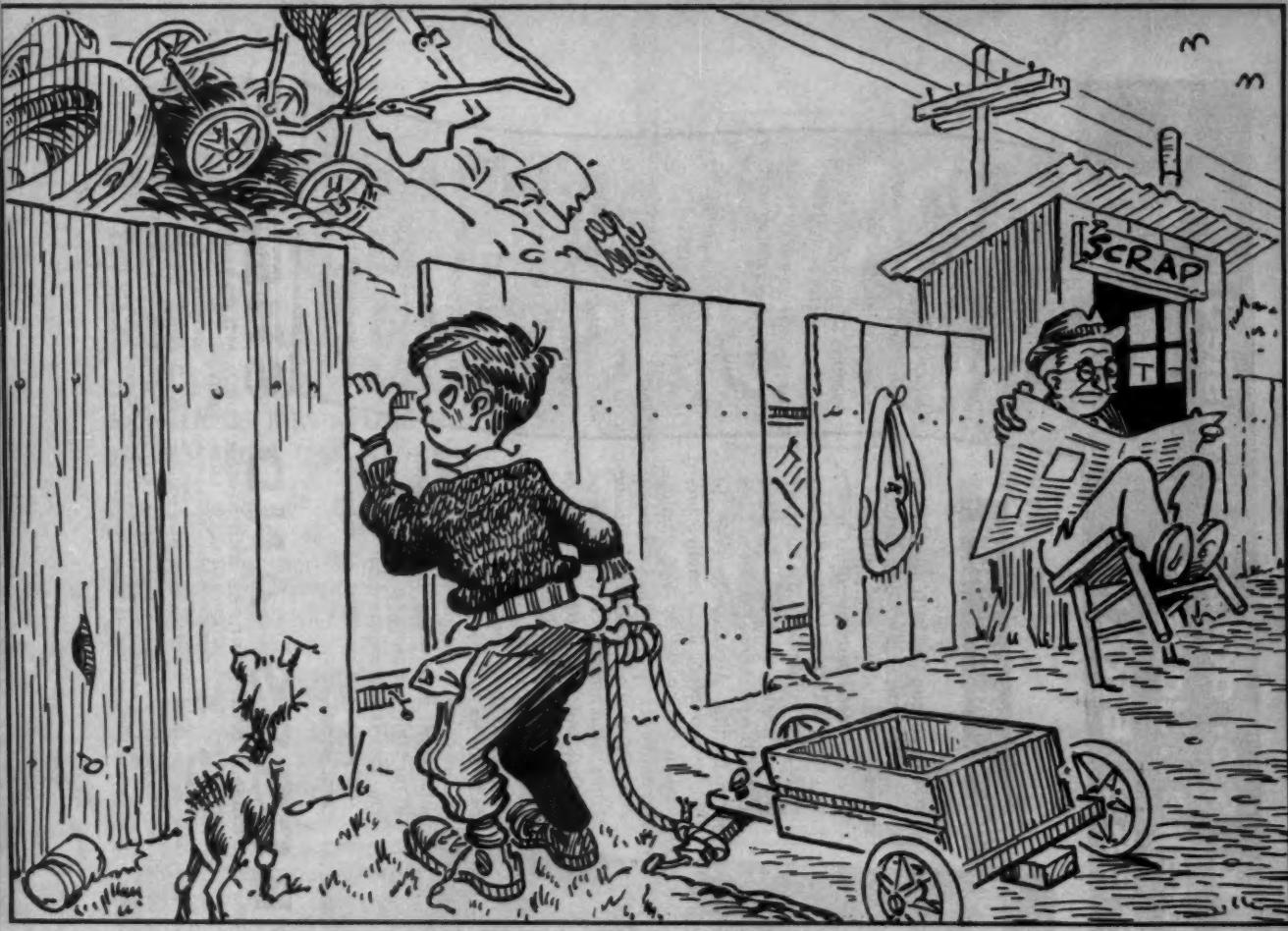
# NEW

Blanchard  
proudly introduces the No. 27-48  
and No. 27-60 Blanchard Surface Grinders,  
which offer new features and high-production capabilities  
that give you high-speed, precision grinding at lower-than-ever  
cost. These new Blanchards are of "dry base" design. All coolant  
and chips discharge from the grinder base. They are powered by a 60  
or 75 HP main spindle motor. Coolant is directed both to the inside and  
outside of the grinding wheel. These features provide ample power,  
rigidity and coolant flow for heavy stock removal on a large variety  
of work pieces. The advanced design and careful construction  
of these machines assure you of great accuracy, extreme  
flatness and fine finish.

THE BLANCHARD MACHINE COMPANY  
64 State Street, Cambridge 39, Mass., U. S. A.



V-561



**REMEMBER WHEN . . .**

## You Couldn't Afford Scrap?

You still can't! As a manufacturer, one of the primary problems you face today is probably the reduction of scrap. Many manufacturers are using American machine tools to lick the scrap problem.

Take the United States Beryllium Corporation, for example . . .

To produce 9" diameter memory drums for computers from the light but strong space-age metal, beryllium, requires extreme precision. Specifications for these drums called for lathes which would hold flatness, roundness, squareness and size to .0001" or less. Because the raw material is extremely expensive, scrap would be disastrous. Anything less than the best lathe could not be considered.

That's why the United States Beryllium Corporation plant at Inglewood, California chose American Lathes. According to Mr. Frank Hevrdejs, Vice President of U. S. Beryllium, their Americans are turning perfectly round within .000050" to help produce these beryllium memory drums with an absolute minimum of scrap.

"Impossible" jobs are routine for American Lathes. Thanks to their carefully engineered rugged

design, they keep on performing their accurate jobs year after year in tool room, maintenance and production applications.

If you have a scrap problem, contact your American distributor. Learn how you can secure American Lathes and American Radial Drills on "Toolease," our popular leasing plan. Or, write Section 164 at the address below. Ask for bulletins 116 and 801.



American Lathes perform precision turning in the "hospital clean" shops of the United States Beryllium Corporation.



### THE AMERICAN TOOL WORKS COMPANY

PEARL STREET AT EGGLESTON AVENUE • CINCINNATI 2, OHIO

# 15 years engineering and millions of dollars invested to perfect the world's finest brake... today's **PACIFIC HYDRAULIC PRESS BRAKE**

\*

THIS INVESTMENT  
ENABLED PACIFIC

TO INTRODUCE:

- Tape control to synchronize cylinders within .002" (1947)
- Cushioned punching (1949)
- Precision depth control to repeat accuracy within .001" (1951)
- Manual turret stroke controls for progressive bending (1952)
- Selective anti-whip speeds to eliminate reverse bends (1952)
- Tandem operation of press brakes for forming pieces 40 ft. or longer (1953)
- Tonnage control to protect light dies in heavy press (1953)
- Multiple hydraulic cushion cylinders for deep drawing (1954)
- Overhead integral power unit for increased accuracy (1955)
- Cylinder ram guides for increased rigidity (1956)
- Shearing attachment for shearing heavy plate on press brake (1958)
- Pipeless stacking of valves to eliminate pipe breakage and leakage (1959)
- Shockless hydraulic valving to eliminate cause of leakage (1959)

## VERSATILE COMBINATION PRESS BRAKE AND SHEAR

With the unique PACIFIC shearing attachment, General Electric Company, Elyria, Ohio, shears heavy plate and forms sheet metal parts on its PACIFIC press brake. In cutting  $\frac{1}{2}$ " to 1" plate, the PACIFIC minimizes slow burning, increases shearing capacity of the plant and equals conventional shears in high speed cutting. Accuracy of .060" to .090" over 6 feet of shear length is provided in cutting  $\frac{3}{8}$ " to  $\frac{3}{4}$ " stainless and mild steel up to 1" thick. Shearing with a cushioned, shockless hydraulic stroke, attachment is still cutting on original knife edge after 6 months of use. Operating half the time as a press brake, the PACIFIC forms mild and cold rolled steel, stainless and inconel parts for jet engines. Horn on left end of ram permits forming while shearing attachment is in place. Jack-type conveyor table operating on trolley tracks on floor is contemplated for rapid installation and removal of shearing attachment.



Over 9 out of every 10 hydraulic press brakes in operation today are PACIFIC providing . . .

- More dependability
- Freedom of maintenance and leakage
- Simpler electric controls
- Simpler hydraulic control
- More accuracy in level bending
- More operating convenience
- Greater visibility
- More rigidity in cylinder construction
- Shock-free hydraulic system suitable for punching

## **PACIFIC PRESSES AND SHEARS**

### **PACIFIC PRESS AND SHEAR CORP., MT. CARMEL, ILL.**

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# CAM BORE PRECISION... AT THREE TIMES THE SPEED OF A BAR AUTOMATIC

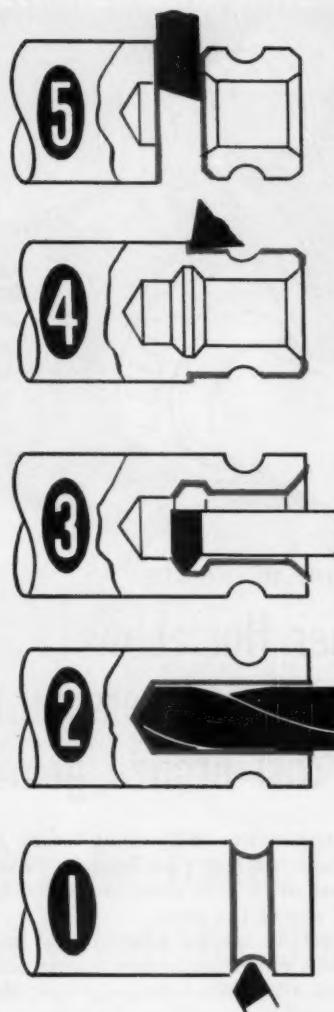
**STANDARD STYLE 308 BORES AND  
CONTOURS MINIATURE BEARING  
RACES FROM BAR STOCK**

Take a standard Ex-Cell-O Style 308 Cam Boring Machine, feed bar stock through its Ex-Cell-O Precision Spindles, and add the tooling shown at right.

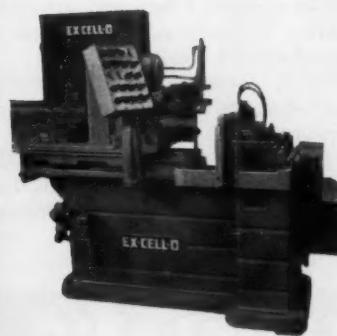
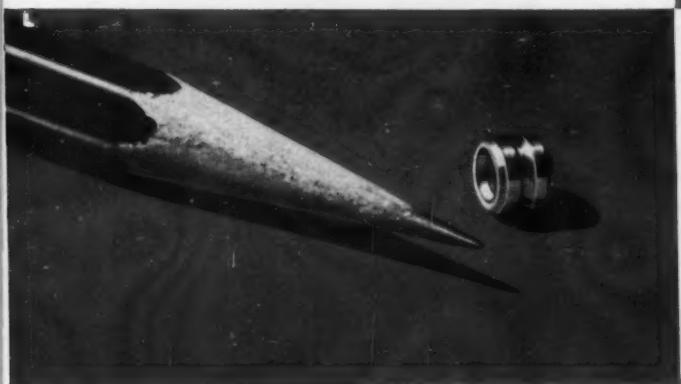
The result: 380 miniature bearing races per hour, gross—produced three times faster, 10 times more accurately, and with more operations and a finer finish than possible with the bar automatic assigned to the same work!

Ex-Cell-O Precision Cam Boring Machines use direct cam action on table and cross slide to perform an endless variety of boring and contouring work. To change the part form, the operator simply changes two convenient cams and tool blocks.

How many ways can you use a versatile boring machine like this in your work? Get the fact-story from your Ex-Cell-O Representative, or write direct for details on the complete line.



ABOVE: Operations are (1) generate track, (2) drill, (3) back chamfer and contour bore I.D., (4) face, chamfer and turn O.D., (5) chamfer O.D. and cut-off. LEFT: Style 308 Cam Boring Machine. FAR LEFT: Part (shown 2½ times actual size) is 440C stainless steel. Tolerance is held to plus or minus .00025", finish to 20 RMS.

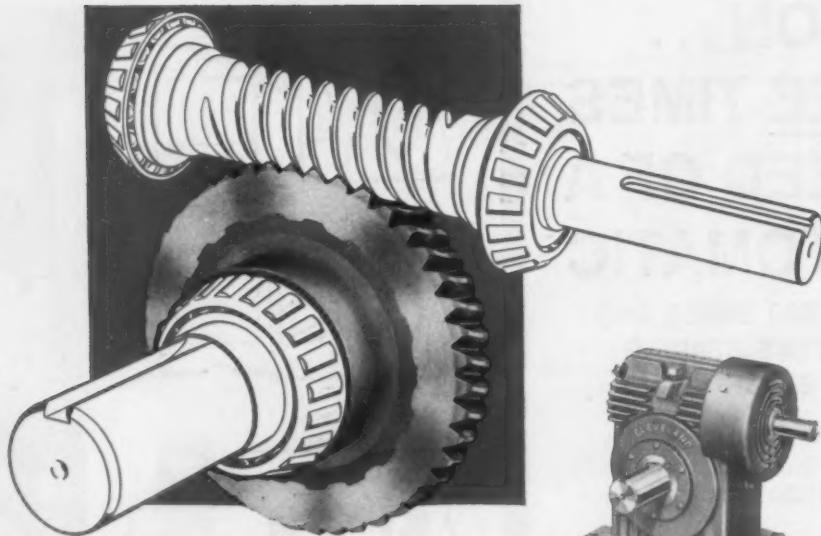


**EX-CELL-O FOR PRECISION**

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS  
• DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND SAGING EQUIP-  
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ENERGY EQUIPMENT • RAILROAD PINS AND BUSHINGS • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

**EX-CELL-O**  
CORPORATION  
DETROIT 32, MICHIGAN



*for longer trouble-free service life*

## ...New Higher Horsepower Cleveland Speed Reducers feature centrifugally cast bronze gears

Providing higher input horsepower and output torque ratings, New Cleveland Speed Reducers now give industry dependable speed reduction at savings of 50% or more on per horsepower cost—without increasing size of the units.

Playing an important role in helping achieve these improved new ratings are Cleveland's centrifugally cast bronze gear rims of a high copper-tin-nickel alloy. When properly cast, this material provides highest strength compatible with requirements that it be free from abrasive crystalline components. Yet it's yielding enough to avoid excessive loading stress localization, while affording a low coefficient of friction against hardened steel—providing increased resistance to wear and fatigue pitting.

These rugged bronze rims are cast integrally with their supporting cast iron hubs (see photo at right). Checkered hub circumference holds the rim securely in position, making the two members independent of actual surface bond.

Also, another plus value of the New Cleveland Reducers is their especially large gear shaft diameters—which provide greatly increased overhung load carrying capacity.

For complete facts on this New Cleveland Speed Reducer Line, consult your local Cleveland Representative. Or, write us direct for free Bulletin No. 405—it gives complete engineering information for designers and engineers.



**Cleveland Worm & Gear Division**  
Eaton Manufacturing Company  
3276 East 80th Street • Cleveland 4, Ohio



# Monarch's Building Higher Production for Tomorrow's Boom

THE LATHE  
ON YOUR FLOOR  
WILL PRODUCE  
MUCH MORE



## 3..The New Air-Tracer Pak... Portable Unit for Standard Monarchs in Your Plant

Here's a real turning technique breakthrough! The Air-Tracer Pak is just what the name implies—a portable, easily applied device for temporarily or permanently adding to many standard Monarchs in your shop *all the advantages of Air-Gage Tracer production.*

And what are those advantages? In a nutshell, this, the most accurate duplicating method in general use, always outproduces manual operation up to 8 to 10 times. It sizes automatically and, using only a single running tool, is ideal for *small lot repetitive work*

without the need for expensive form tools or multiple tool setups.

Its accuracy of  $\pm .001"$  on most work often cuts in half the stock left for grinding; sometimes eliminates grinding and polishing. It allows complete setup change in as little as 15 to 20 minutes and tool change in 1 minute. It is also the simplest, most trouble-free of all lathe duplicating units.

The photos show how the tracer slide assembly quickly replaces the regular compound rest on the cross slide. Note the template support and micrometer dials—the portable, completely self-con-

tained power unit at the front of machine with air supply and electrical connections in the base.

Presto! it's on. And presto! it's off. Yet it's an adaptation of the time-tested swiveling Air-Gage Tracer with the versatility to handle the more complex turning, boring and facing jobs.

This is news! Write—or phone today—for the full story... The Monarch Machine Tool Company, Sidney, Ohio.

**Monarch**  
TURNING MACHINES

IF IT CAN BE TURNED, THERE'S A MONARCH TO DO IT BETTER AND FASTER

Deriving from well-known NADELLA Needle Thrust Bearings

NADELLA  
HIGH-PRECISION  
NEEDLE THRUST BEARINGS

ensure perfect axial retention of machine  
tool spindles and other high-precision  
rotating machine components.

Exceptional Load Capacity

Outstanding Rigidity even under Variable Load

Normal Tolerance  $\pm .00004"$

(closer tolerances on request)

Bearing precision completely unaffected by centrifugal forces acting on rolling elements

These thrust bearings are suitable for all normal speed ranges, including high-speed machining by carbide and ceramic cutting tools. NADELLA Needle Thrust Bearings meet tomorrow's machining precision requirements today. You can safely put your trust in the traditional craftsmanship and skill of Swiss precision engineering backed by NADELLA's 30 years experience in the production of needle bearings. Complete range of metric sizes from 15 mm (19/32") to 120 mm (4 3/4").

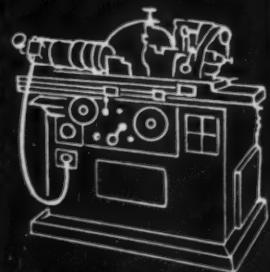
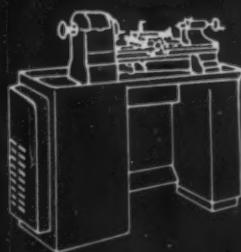
Some typical applications where NADELLA super-precision needle thrust bearings have scored:

- **Precision lathe spindle**, mounted on 35 mm (1 3/8") i. d. NADELLA needle thrust bearings. Excellent surface finish, outstanding dimensional accuracy of machined faces, direct finishing to closed tolerances.

- **Worm of indexing table for jig boring machine**, mounted on 40 mm (1 9/16") i.d. NADELLA needle thrust bearings (ultra-precision grade). Indexing accuracy  $\pm .00001"$ .

- **Milling machine spindle**, mounted on 120 mm (4 3/4") i. d. NADELLA needle thrust bearings. Performance proved so satisfactory that preliminary rough machining passes produced a surface precision and finish equal to the finishing pass.

- **Work-holding spindle of grinder**, mounted on 50 mm (2") i.d. NADELLA needle thrust bearings. Complete absence of lateral movement and outstanding dimensional accuracy in surface grinding; excellent surface finish.



WÄLZLAGERFABRIK BIEL A. G.

SOLOTHURNSTRASSE 66/68 - BIEL (SWITZERLAND) TEL. 032-4.20.31

► **HIGH SHEARING SPEED**—Up to

18,000 cuts per 8 hour shift.

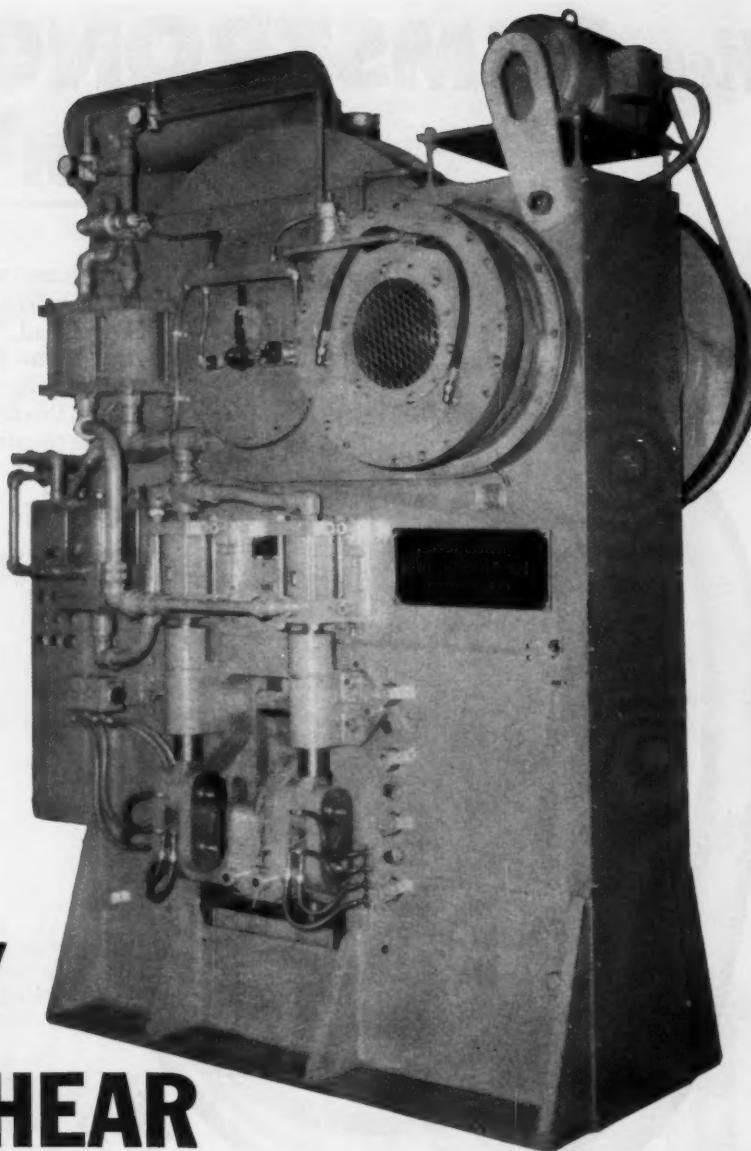
► **CLEAN, SQUARE CUTS**—Shows up hidden defects.

► **COMPACT DESIGN**

—Saves floor space.

► **AUTOMATIC FEED TABLES**—Available

to your requirements.



# 'BUFFALO' BILLET SHEAR

Now—enjoy peak production on your billet cutting jobs. This new 'Buffalo' Billet Shear is ruggedly-built for maximum years of dependable, trouble-free performance. Greatest output at lowest cost is assured by efficient high speed operation. Clean, square cut billets

permit high quality finished forgings. Features include alloy steel frame, electrical controls and pneumatic automatic oiling system.

For full details, including capacities available, contact your machine tool dealer or write us direct.



'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

MACHINE TOOL DIVISION  
**BUFFALO FORGE COMPANY**

Buffalo, New York  
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.



'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.



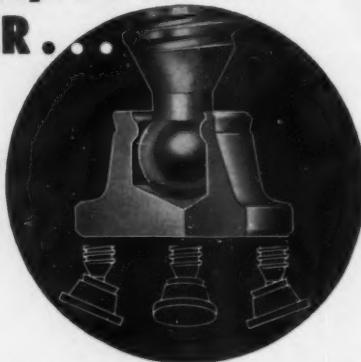
Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

# New ARMSTRONG Swivel Pad can't come off



Now ARMSTRONG deep throat "C" Clamps have the new (Pat. apd. for) ARMSTRONG Ball-joint Swivel Pad. This "C" Clamp pad, developed by ARMSTRONG Engineers, is tougher than any on the market. Rigorous testing in our own plant first proved this fact, and field tests in factories throughout the country have confirmed our own test results.

**Here's Why it's  
STRONGER . . .**



The lip of the opening in the ARMSTRONG Ball-joint Swivel Pad is undercut so that when the ball of the screw is inserted, and the lip is permanently forced down, a solid steel wall is formed, inside the pad cavity, completely encircling the ball.

This wall of steel makes it impossible for the pad to come off the screw during normal use. In fact, our tests have proved that it is virtually impossible to intentionally knock the pad off with a hammer — yet the pad is free to swivel through an arc of approximately 40°.



**Call your ARMSTRONG Distributor**

Your ARMSTRONG Distributor can offer delivery from stock on this "400-Series" deep throat, drop-forged "C" Clamp with the new Ball-joint Swivel Pad. He also carries in stock the other styles of clamps in the ARMSTRONG Line—the broadest line of drop forged "C" Clamps.

**ARMSTRONG BROS. TOOL CO.,**

5213 W. ARMSTRONG AVE.  
CHICAGO 46, ILLINOIS

for accuracy in your production  
it pays to specify

## UNIVERSAL DRILL BUSHINGS

In Universal you get the best. Machined from finest quality steel. Blended radius on the top inside diameter helps prevent tool hang-up and breakage. 100% concentricity and hardness tests insure accuracy and uniform quality. Knurled heads provide a quick, sure grip.

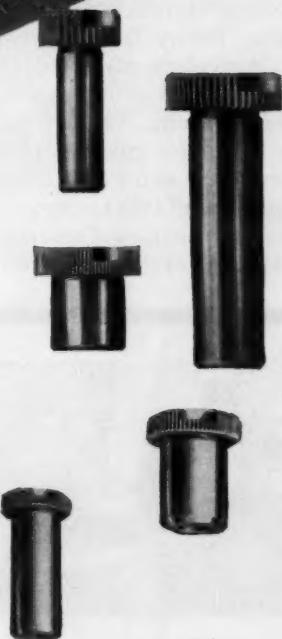


superfinish bores  
lengthen tool life.

The superfinishing of Universal Drill Bushings is an important factor in keeping tool and bushing wear to a minimum—especially in close tolerance work.

Standard sizes and lengths in stock for immediate delivery. Contact the office nearest you—Universal Engineering Sales Co., 1060 Broad St., Newark 2, N. J.; 5035 Sixth Ave., Kenosha, Wis.—or our home office.

Write for your copy of our new 98 page catalog describing Standard Collet Chucks, Floating Collet Chucks, Boring Chucks, "Kwik-Switch" Tool Holders, Mikro-Lok Boring Bars, Standard Drill Bushings, Universal Insulated Plungers and other Universal products.



### UNIVERSAL ENGINEERING COMPANY

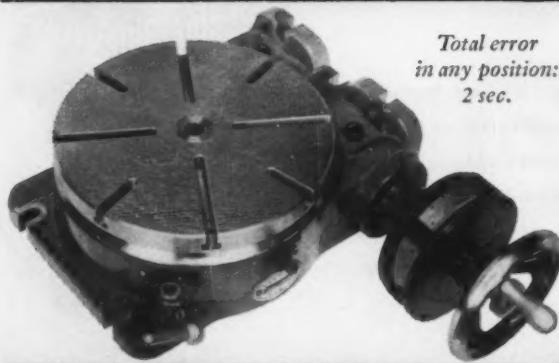
FRANKENMUTH 2,  
MICHIGAN

# MOORE ROTARY TABLES

For angular spacing jobs so precise you could never handle them before

NO. 2 ULTRA PRECISE TABLE:

**Reads direct to 1 sec.**



Total error  
in any position:  
2 sec.

GUARANTEED POSITIONING ACCURACY FOR SHOP USE

All points in 90° increments, from zero to  $\pm 1$  sec.  
All points in 18° increments, from zero to  $\pm 1\frac{1}{2}$  sec.  
All points in 2° increments, from zero to  $\pm 1\frac{3}{4}$  sec.

Worm accuracy— $\frac{1}{4}$  sec.

Repetition of settings— $\frac{1}{2}$  sec.

Total error in any position—2 sec.

2 sec. = .000005" ( $\frac{1}{2}$  tenth) on 10" dia.

Now...with this new No. 2 Moore Ultra-Precise 11-inch 2 sec. Rotary Table—you can provide the closest precision angular spacing needed today. It reads to 1 sec. and has an overall performance accuracy of  $\pm 2$  sec. throughout the entire 360°. It is being widely used in angular locations for guidance systems. A nondisengageable, thread-ground worm, combined with the accurately spaced teeth of its mating gear, makes this extreme precision possible. Loss of accuracy, due to repeated throwing in and out of the worm, is eliminated.

NO. 2 PRECISION TABLE

**Reads direct to 5 sec.**



Total error  
in any position:  
6 sec.

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All points in 18° increments, from zero,  $\pm 2$  sec.  
All points in 2° increments, from zero,  $\pm 4$  sec.

Worm accuracy—2 sec.

Repetition of settings—1 sec.

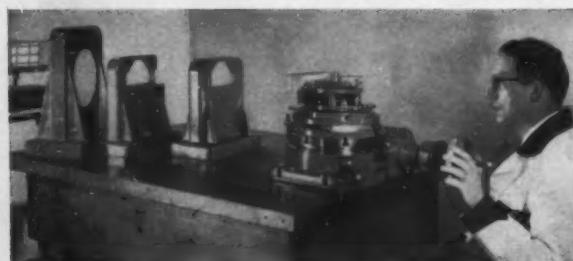
Total error in any position—6 sec.

6 sec. = .00015" ( $\frac{1}{2}$  tenths) on 10" dia.

This popular No. 2 Moore Precision 11-inch Rotary Table has an overall performance accuracy of  $\pm 6$  seconds throughout the entire 360°, and reads direct to 5 sec. It is being used successfully by leading companies on government-sponsored precision jobs never before accomplished. You can use this rotary table for countless precision spacing applications on jig borers and jig grinders.

\* \* \*

Write today for descriptive literature about the Moore 2 sec. Ultra-Precise and 6 sec. Precision Rotary Tables.



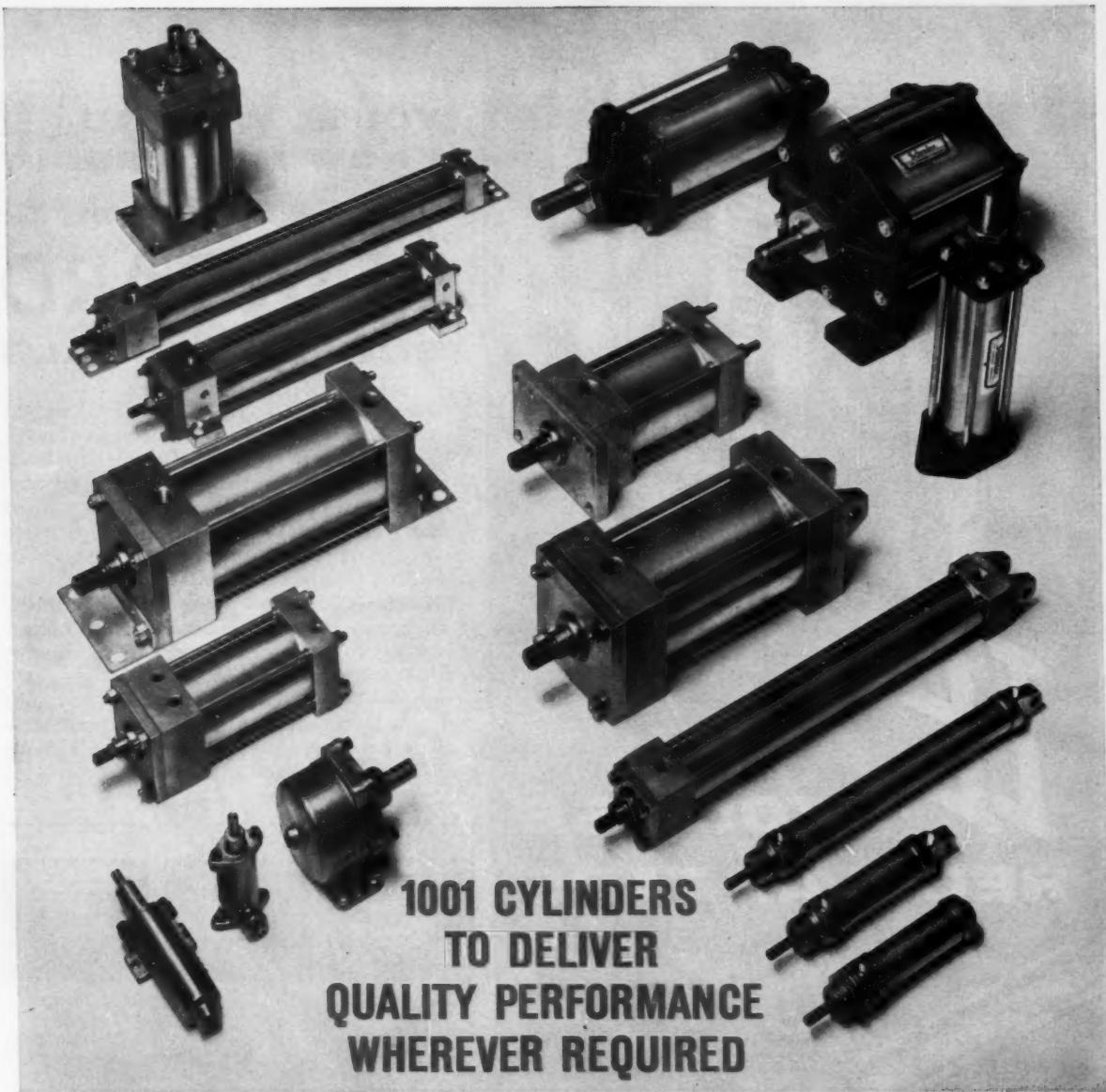
Accuracy assured by interferometric inspection and calibration, the first time industry has used light-wave measuring methods for precise division of the circle.

These rotary tables are accurate in either horizontal or vertical position. Further applications are possible by using the table in conjunction with its companion unit, Model No. 2 Sine Plate.

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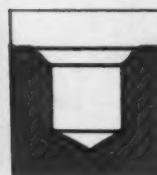


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STANDARD  
SUBLAND DRILLS**

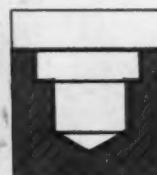
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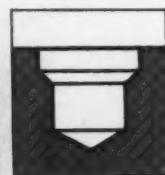
And—they're easy to select for any job, because Mohawk (and their distributors) stock all practical sizes in 3 step lengths and 3 shank styles for immediate deliveries.



Subland Drill-Chamfer  
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Fluteless Taps  
Pipe Taps  
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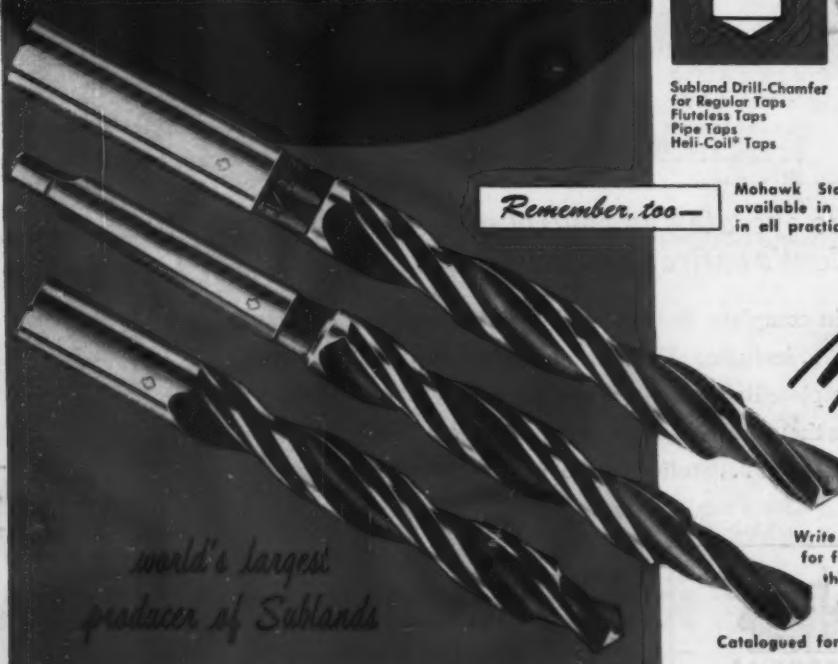
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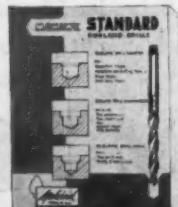


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Powered by 200 hp motors, these machines can handle pieces up to 46 ft. long.

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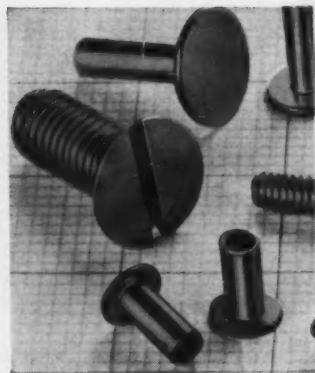
You don't baby a NILES—it's no baby



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Industrial Equipment Division, Philadelphia 42, Pa.

**Cold heading is a high-speed, high-volume process even with intricate parts requiring secondary operations. Die sets are not expensive—set-up time is moderate. Scrap is no factor. Cold working improves mechanical properties. Use the handy chart and comparative data covering 14 suitable Anaconda alloys to open the door to some sizable savings. Take a second look at the way you're making parts like those at the right—and connector components in electrical controls—and bases for semiconductor devices.**



## Fast, low-cost cold heading with these Anaconda

Alloys and Nominal Compositions, %	Temper*	Prop. Limit, 1000 psi	Yield Str., 0.2% Offset, 1000 psi	Tensile Strength, 1000 psi	Red. Area, %	Plasticity Index, %
<b>Brasses</b>						
Commercial Bronze-14 90 Cu, 10 Zn	A	20.5	43.0	51.0	85	40
	B	39.0	57.5	64.0	81	61
Red Brass-24 85 Cu, 15 Zn	A	23.0	49.5	55.0	82	42
	B	42.0	62.0	71.0	77	59
Low Brass-32 80 Cu, 20 Zn	A	33.5	50.0	57.0	81	59
	B	44.0	65.0	76.5	79	58
Cartridge Brass-42 70 Cu, 30 Zn	A	32.5	51.0	63.5	80	51
	B	48.0	70.0	82.5	73	58
Yellow Brass-58 65 Cu, 35 Zn	A	38.0	52.0	62.0	79	61
	B	52.5	70.5	81.0	72	63
<b>Cupro Nickels</b>						
Cupro Nickel, 10%-735 88.35 Cu, 10 Ni, 1.25 Fe, 0.4 Mn	A	38.5	52.0	54.0	81	71
	B	56.5	76.5	79.0	80	72
Cupro Nickel, 20%-712 79.5 Cu, 20 Ni, 0.5 Mn	A	34.5	57.5	60.5	83	57
	B	46.0	69.5	74.0	74	62
<b>Nickel Silvers</b>						
Nickel Silver, 18%-716 72 Cu, 9.75 Zn, 18 Ni, 0.25 Mn	A	37.5	57.5	60.0	83	62
	B	39.5	64.5	67.5	78	59
Nickel Silver, 12%-744 65 Cu, 22.75 Zn, 12 Ni, 0.25 Mn	A	43.0	58.0	67.0	77	64
	B	50.5	81.0	86.0	73	59
<b>Tin Bronzes</b>						
Phosphor Bronze, (A)-351 94.75 Cu, 5 Sn, 0.25 P	A	38.0	60.5	66.0	83	58
	B	50.0	80.0	87.5	79	57
Phosphor Bronze, (C)-353 91.75 Cu, 6 Sn, 0.25 P	A	44.0	64.0	76.5	81	58
	B	57.0	90.0	99.0	76	58
Phosphor Bronze, (D)-354 89.75 Cu, 10 Sn, 0.25 P	A	49.5	73.5	86.0	71	58
	B	66.5	101.0	111.0	69	60
<b>Leaded Copper-126</b>						
99 Cu, 1 Pb	A	20.0	40.0	41.5	89	48
	B	27.5	48.0	51.5	84	53
<b>Copper-Silicon Alloy</b>						
Everdur®-1015 98.25 Cu, 1.5 Si, 0.25 Mn	A	34.5	54.0	55.5	81	62
	B	43.5	67.0	74.0	76	59

\*The temper designations "A" and "B" have no commercial significance.

This table includes results of special tension tests made in Anaconda laboratories. It is a useful guide to the right copper alloy for a cold heading job.

**Each alloy is shown in two standard tempers, A (1/4 hard) and B (1/2 hard).** These designations show the amount of mechanical strengthening the alloy has been subjected to before cold heading. Though it is assumed that the cold heading process enhances these values, the preheading values are widely used in design—to be on the conservative side. The tempers obtained by wire drawing represent the following cold reductions: A, about 20%; B, just under 40%.

"**Plasticity Index**" is a useful indicator of the amount of cold work an alloy will take. It is the ratio of proportional limit to ultimate tensile strength expressed in per cent. A low value of the index indicates that a large part of the total stress range to fracture is devoted to deforming the alloy plastically. Thus an alloy with a low value

flows more easily during the cold heading, and parts made from it can be designed with greater complexity of shape. For best formability, a low plasticity index should be coupled with a high percentage reduction in area—to minimize shear fracture.

**The effect of alloying elements on mechanical properties** is clearly seen in the table. The main purpose of alloying copper is to increase ultimate and yield strengths. Alloying has other important effects, but the table shows how these alloying elements influence the balance between increased strength and formability in cold heading. In the selection of an alloy for cold heading, this interplay is usually the major consideration—with factors like corrosion resistance, color, surface finish, and cost playing supplementary roles.

**WHAT ALLOYING ELEMENTS DO** — Addition of a second element, or a series of elements, to copper affects the crystal structure so that flow in certain directions becomes difficult except by going to higher stress levels. The effect depends not only on the element added but on its proportion in the matrix. Here are brief descriptions of how the various major alloying elements influence the engineering behavior of copper metal:

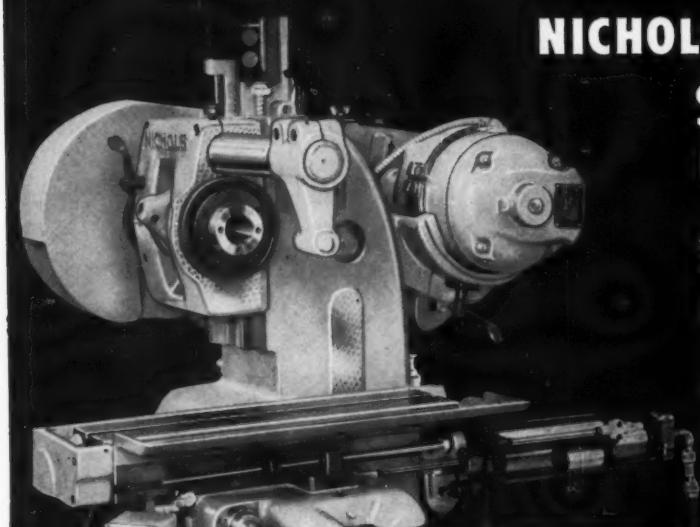
**ZINC** plus copper makes brass up to 20%, the "low brasses"; from 20% to about 35%, the "high brasses." The addition of zinc substantially improves strength, yet the metal retains good formability (a low plasticity index with high reduction in area). Malleability does, however, decrease as the percentage of zinc increases. The diagram on the next page illustrates how a choice is made between alloys of similar zinc content. Thermal and electrical conductivity decrease as zinc content increases, and color changes from reddish hue to greenish yellow. **NICKEL**, the principal alloying element in the cupro nickels, improves resistance to corrosion. In the nickel silvers, nickel and zinc also control color. As nickel content increases, color moves from brass shades to silver white. Both cupro nickels and nickel silvers have high percentage reduction in area. Their slightly higher plasticity index tends to reserve their use to parts requiring exceptional corrosion resistance.

**TIN** as the main alloying element in the phosphor bronzes contributes high tensile and yield strengths, along with excellent fatigue resistance. For cold heading, the biggest advantage of phosphor bronzes is their favorable combination of low plasticity index and

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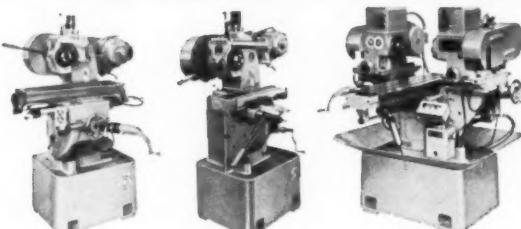
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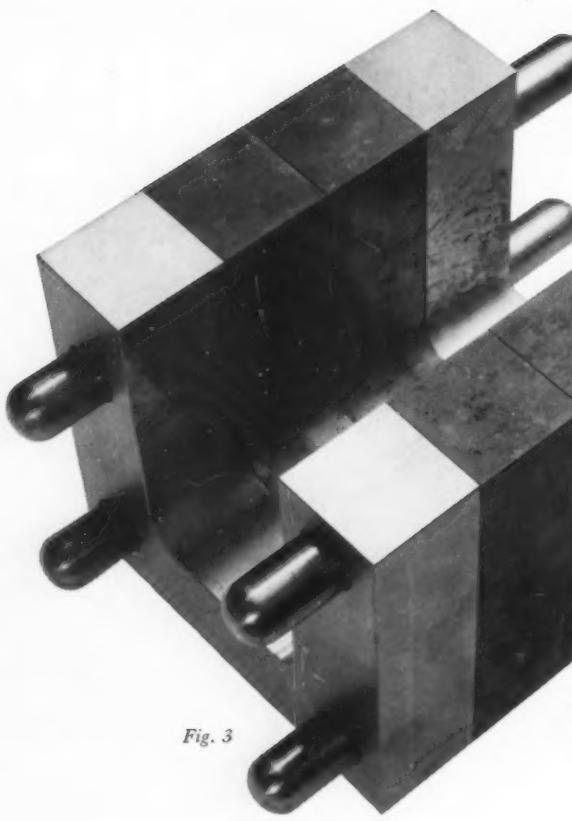


Fig. 3

# DISTORTION AND SIZE CHANGE HELD TO LESS THAN .0002" PER INCH WITH GRAPH-AIR® TOOL STEEL

The test pieces pictured here demonstrate the dimensional stability of Graph-Air® tool steel that enables users to produce more intricate tools and dies.

Fig. 1 shows test piece dimensions. In the "U" shape, which is particularly sensitive to distortion in heat treating, the machining tolerance be-

fitted together by four pins having a diameter of .0003" under .500". The total assembly error under these circumstances could not exceed .0008". Distortion must be less than .0002" per inch during heat treatment for the pins to fit.

The Graph-Air pieces tested were from different heats. They were air hardened from 1450°F. and double tempered at 400°F. Fig. 2 shows them as they pegged together easily, demonstrating no distortion. Fig. 3 top, shows the same specimens compared with two green, or as machined, parts. They matched perfectly again. Graph-Air did not distort . . . did not change

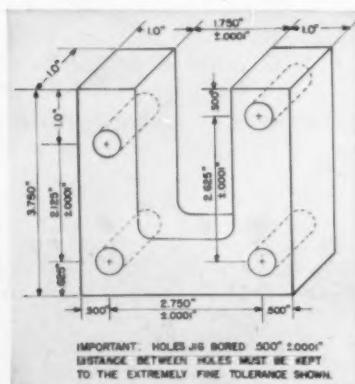


Fig. 1  
between any two holes is held to .0002". After heat treating, the specimens are

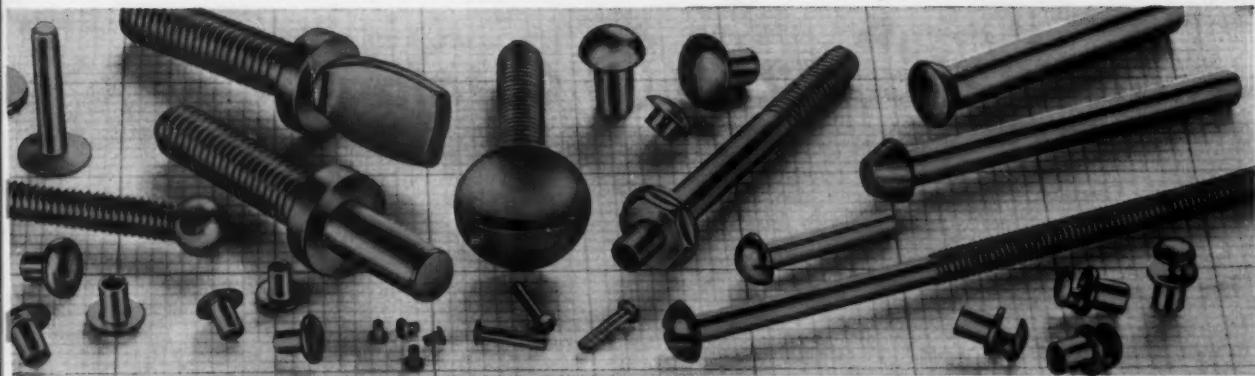
size. Records indicate that no other tool steel passed this test when heat treated at its recommended hardening and tempering conditions.



Fig. 2

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high reduction in area—second only to the straight brasses. Electrical and thermal conductivities drop as tin content increases.

**LEAD** enhances the machinability of copper by acting as an embrittling agent, correspondingly reducing the per cent reduction in area, but with little effect on the plasticity index. For cold heading, this means that even though the plastic range is great, there is a limiting amount of work hardening that can be reconciled with shear strength. Though it is not recommended for shapes where shear forces predominate in the cold heading operation, Leaded Copper-126 has some very interesting advantages. It has an electrical conductivity rating of 98% IACS and a machinability rating of 80 (free-cutting brass = 100) for economical secondary operations. It offers a possible means of

reducing the cost of electrical connector components, where shape and tolerances are within the range of cold heading capabilities.

**SILICON** content of 1.5% adds toughness to copper and improves its ductility — providing a combination of plasticity index and reduction in area favorable to cold heading. Such an alloy is well-suited to impact applications, particularly where very low temperatures are met, as in cryogenic equipment. As the lower copper-silicon alloys work-harden less rapidly than those of higher silicon content, Everdur-1015 (shown in the table) was developed for cold headed parts, especially where secondary operations, like roll-forming of threads, are required.

**UPSET RATIO IS IMPORTANT** — The alloys and alloy groups shown in the table are all suitable for cold heading. Often, however, the precise strength level or the exact service conditions are not known. Then the best guide is the approximate amount of cold work needed to form a given upset. This is the upset ratio—the ratio of final upset diameter to the original wire diameter.

**WHEN UPSET RATIO IS FROM 2 TO 3**, only one or two blows are usually necessary, and the choice of material is not critical. Any alloy from the table, in any temper, will be suitable.

**WHEN UPSET RATIO APPROACHES 4.5 TO 5**, two or more blows are necessary, and selection of material becomes critical. Choice is usually made after trial heading of one or more possible combinations of alloy and temper.

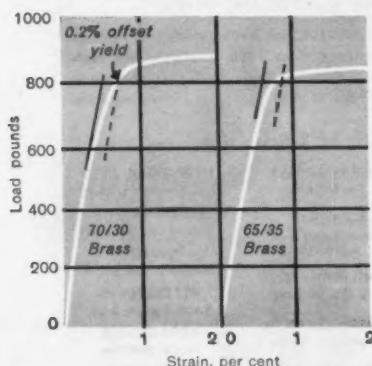
**FOR UPSET RATIO OVER 5**, multiblow or progressive heading must be employed, and annealing between blows may be necessary. Here only alloys with the most favorable combination of plasticity index and per cent reduc-

tion in area should be considered.

**SEMICONDUCTOR BASES.** As quantities of these components soar, cold heading should be considered for economical production. Many of the copper alloys offer the high electrical and thermal conductivities needed. But severe heat cycling in manufacture rules out the cold heading alloys listed. The metal must be deoxidized or oxygen-free to resist hydrogen embrittlement. For secondary operations, it must also have good machinability. And where high torque is used to tighten the base to the heat sink, it must in addition have high strength. Various combinations of these properties are found in such alloys as DLP Copper-104, OFHC\* Copper-120, Tellurium Copper-127, and Chromium Copper-999 — all available as cold heading wire.

**TECHNICAL SERVICE.** Although Anaconda American Brass does not produce cold headed parts, it does make cold heading wire in the wide variety of alloys and tempers required. Anaconda has specialists in this field to help you select the right material for your job. Simply give us a sample, sketch, or description of the part or parts—along with service conditions, quantities, properties required — for a recommendation. See your Anaconda representative, or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

\*Trademark American Metal Climax Inc.



**Which is more ductile?** — 70/30 brass or 65/35 brass? These load-strain curves on the two alloys in temper A ( $\frac{1}{4}$  hard, 18% reduction) show 70/30 cartridge brass is slightly more formable—because it begins to flow plastically sooner than the 65/35, yet continues to deform to a higher ultimate load. Thus the plasticity index is lower. This, combined with higher per cent reduction in area, makes 70/30 a better choice when shear is a major factor.

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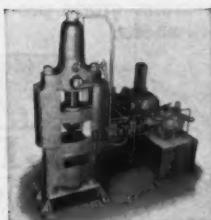
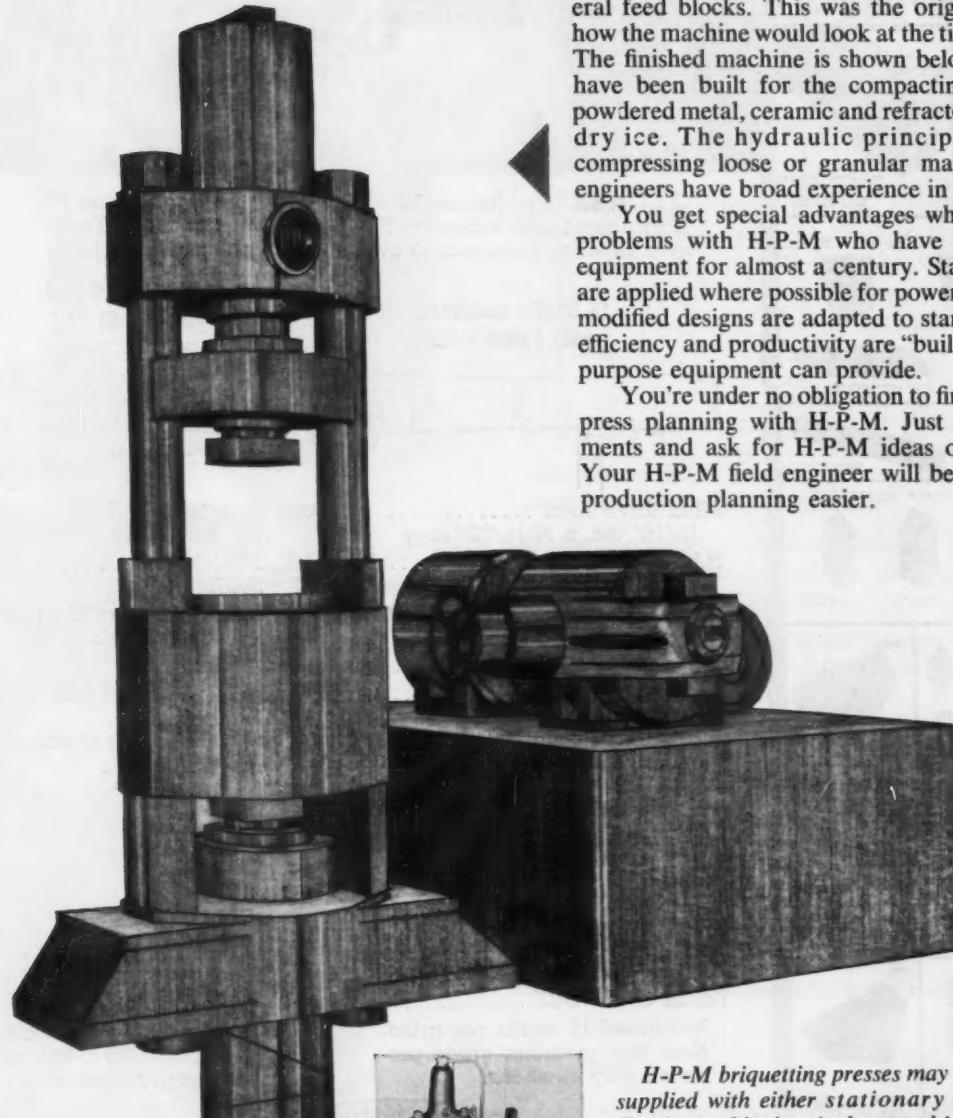
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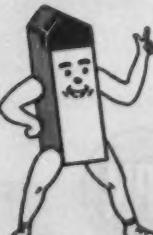
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65

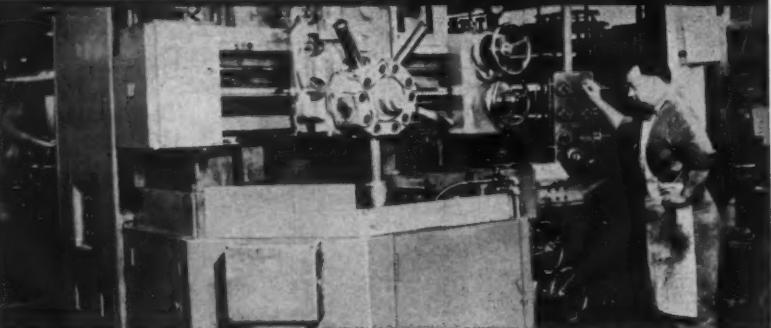
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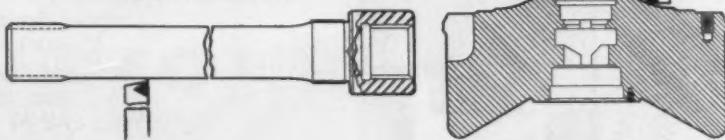
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with Talide C-91



Main drive shaft ..... Part. Rear tractor wheel  
15/16" dia. x 16-15/32" long 15" dia. x 7-19/32" thick  
H.R. A-8640 steel ..... Material. Hi-nickel cast iron  
285-321 Brinell SAE111

Turn O.D. of Shaft ..... Operation. Face outer edge of wheel hub, 1/2" wide cut

Carbo-matic ..... Machine. Bullard  
#TN-163P3 Talide ..... Tools. #GL-20 brazed tool,  
Disposable insert off-set style,  
1/2" I.C. x 3/16" thick,  
negative angle,  
3/64" corner radii,  
Grade S-92 1-1/4" x 1-1/4" x 8" shank  
size, Grade C-91

1/16" ..... Depth of Cut. 1/8" to 1/2"  
.009 ..... Feed. .033

115 ..... Speed  
450 ..... (S.F.M.) 210  
(R.P.M.) 39

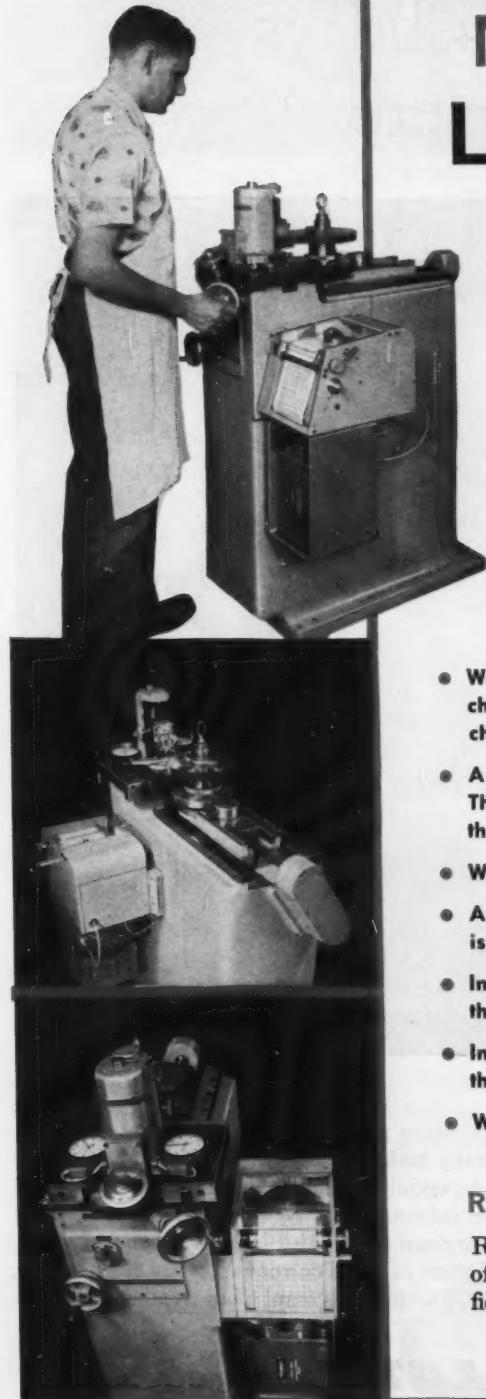
Soluble Oil ..... Coolant. dry  
Talide Grade S-92 ..... Results. Talide Grade C-91  
Machined 18 shafts per grind.  
Next best premium grade produced only 12 shafts.

Machined 600 wheels per  
grind compared to 400 for  
next best premium grade.



# INVOLUTE PROFILES

## Now checked to LABORATORY PRECISION



The New Red Ring Involute Checker was developed primarily to inspect gear shaving cutters for which maximum precision is imperative. It utilizes the base circle technique but with major design modifications and added refinements to increase accuracy, improve dependability and facilitate handling.

### PRINCIPAL FEATURES

- Two dial indicators (.0002" graduations) are provided, one for each side of the tooth being checked.
- With opposed indicators, instrument set-up is quickly verified by checking the work with one, reversing it and making a comparative check at the same point with the other.
- A protractor on the contact finger holder assures proper helix setting. This is pivoted to swing through 180° in order to check both sides of the tooth without angular adjustment.
- Work is mounted on ball bushings to minimize the effect of eccentricity.
- A self-disengaging spindle lock secures spindle while base circle disc is being mounted.
- Indicating slide is mounted on rollers to avoid brinelling or grooving the ways.
- Indicating slide is driven by a self-locking gear mechanism to prevent the slide from running free.
- Work slide is carried on box ways for better control.

### RECORDING

Rectilinear recording on 6 inch tape is provided. Thus, both sides of three teeth can be accommodated on one section of tape. Amplification of 10:1 spreads .050" of finger travel over .50" of graph.

### NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

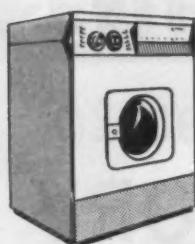


SPUR AND HELICAL GEAR SPECIALISTS  
ORIGINATORS OF ROTARY SHAVING,  
GEAR HONING AND ELLIPTOID

WORLD'S LARGEST  
PRODUCER OF  
GEAR SHAVING AND  
HONING EQUIPMENT

 Whirlpool

Combination washer-dryer, one of the newest of a famous family of home appliances.



# Workless Washdays Start Here



It's a long step from washday back to the Experimental Shop of the WHIRLPOOL CORP., at St. Joseph, Mich. But back there you'll find a battery of South Bend 16" Toolroom Lathes hard at work turning out parts for the prototypes of tomorrow's appliances. The adaptability of South Bends to every

type of operation gets work done quicker . . . their accuracy makes it right the first time . . . and their dependability keeps them on the job with fewer interruptions. Why not find out now how they can make your lathe work more efficient? Prices of 16" Toolroom Lathes start at only \$3230—time payment plan available.

## **SOUTH BEND LATHE**

SOUTH BEND LATHE, INC.  
SOUTH BEND 22, IND.

*Builders of Lathes • Milling Machines • Shapers • Drill Presses • Pedestal Grinders*



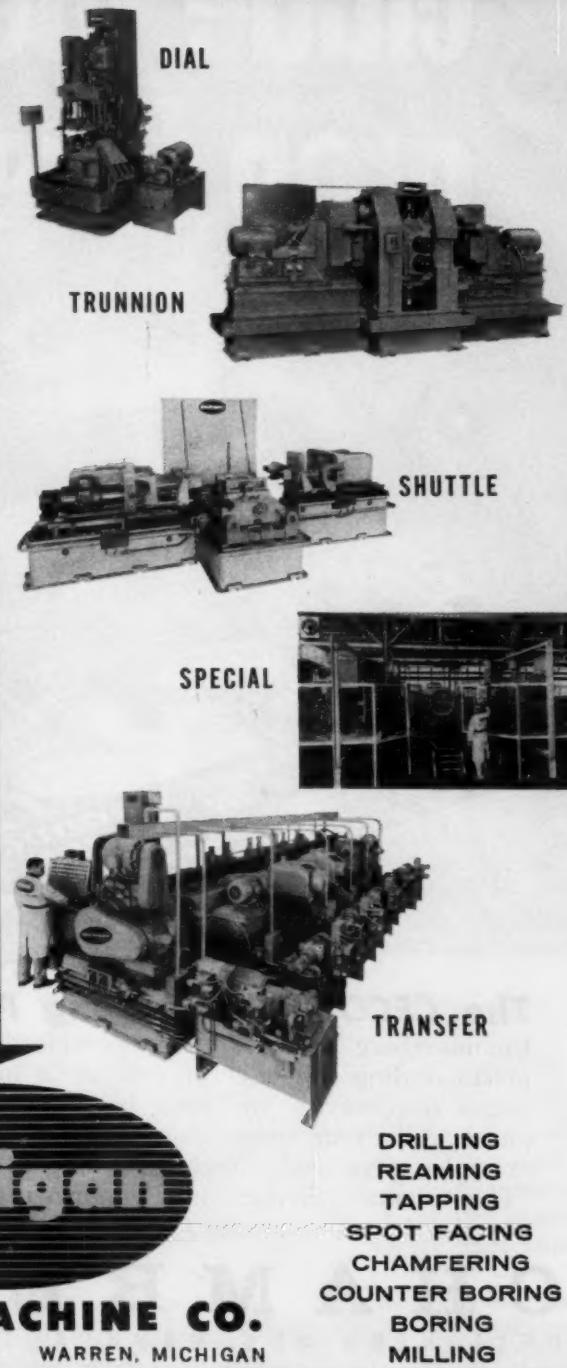
# let's talk CAPACITY

**CAPACITY**, what does this represent in terms of dollars to a prospective buyer of metal cutting machines.

We at **MICHIGAN** feel that manufacturing **CAPACITY** is an important asset and most beneficial time saving aid available. We constantly strive to improve our manufacturing and assembly methods, this in turn increases our **CAPACITY**. The ability to manufacture machines in less time, results in a low product cost to the customer.

- Modern Building.
  - Excellent plant facilities.
  - Complete engineering.
  - National sales staff.
  - Blueprint and duplicating departments.
  - Manufacturing facilities to machine every detail in all of our many components.
  - **MICHIGAN** designs and fabricates electrical, hydraulic and lubrication installations.
- All this represents **CAPACITY**.

**MICHIGAN'S CAPACITY** pays off in savings to our customers. If you're looking for a special metal cutting machine of any kind, remember **MICHIGAN**—we specialize in dependable delivery, low product cost and excellent service. Send us your inquiries, we will be pleased to serve you promptly.

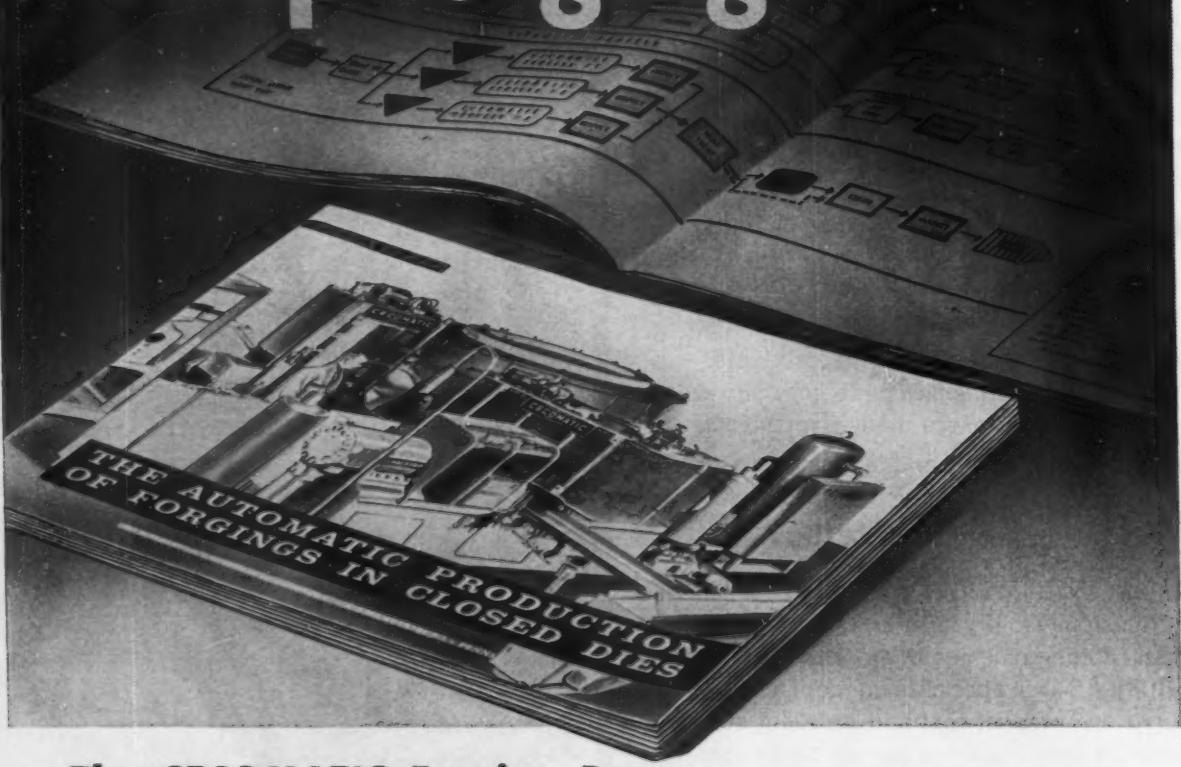


TRANSFER  
DIAL EQUIPMENT  
TRUNNION  
SHUTTLE  
GUN DRILLING  
TAPE CONTROL  
DRILL HEADS  
FIXTURES

**Michigan**

**SPECIAL MACHINE CO.**  
11449 TIMKEN AVE. • WARREN, MICHIGAN

# do your plans include mechanized drop forging?



**The CECOMATIC Forging Process**, based on the revolutionary Chambersburg Impacter, makes possible the continuous and automatic production of precision drop forgings. If you are a manufacturer whose products include drop forged components, you must consider mechanized forging in your plans for the future . . . . your competition will do so—sooner or later. Practical information, with examples of successful mechanized forging operations, are included in the brochure, "The Automatic Production of Forgings in Closed Dies". Write for a copy today, to Chambersburg Engineering Company, Chambersburg, Pennsylvania.

**CHAMBERSBURG**  
DESIGNERS AND MANUFACTURERS OF THE IMPACTER

# TOOL NEWS

- ★ Since 1957, applied in 20,000 special boring, facing, turning, milling and chamfering tools
- ★ Simplifies combining of operations

## WESSON Standardized Cartridge System Revolutionizes Special Tool Field

In only 3 years, the Wesson adjustable cartridge tooling system has revolutionized the design of thousands of multiple point tools for boring, milling, chamfering, turning and facing. (For examples, turn the page.)

The standard 5 styles shown below, alone, cover the vast majority of all special multi-point tool requirements resulting in minimum inventory cost, minimum tool design and fabricating cost. From 2 to 18 or more operations may be combined in a single tool with the Wesson cartridges. Adjustable in two directions, the cartridges with their throw-away inserts cut down-time for setup and tool changes. They come in 5 styles (for square, triangular or pentagonal inserts) and in left and right hand types.

The same cartridge can be used for machining

*This little cartridge is the simple answer to thousands of special tool needs.*

different materials simply by switching to the required Wessonmetal grade. When a tool is no longer needed, cartridges can be switched to other uses. Damaged cartridges can be quickly replaced from stock, avoid high special tool replacement cost.

You can often use special tools for different size parts by simply adjusting the cartridges. Designed to provide maximum chip clearance and to protect the cutter body, cartridges are rigidly retained in the body.

Get our latest bulletin (C-660) on these standardized cartridges by circling A-2 on the Readers' Service Card. Circle A-1 and our representative in your area will show you numerous illustrations of some of the 20,000 different special tools in which these cartridges have proven themselves.

Please turn the page . . .



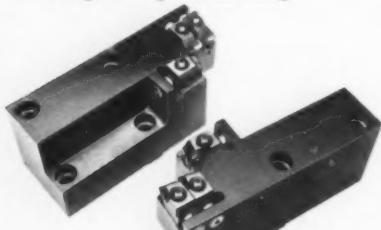
These 5 cartridges will take care of almost all special tools.

# Some of the many specials using WESSON cartridges



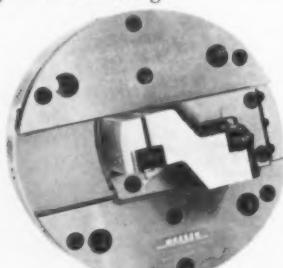
## AUTO TRANSMISSION CASE

15 different operations with one tool—boring, facing, chamfering.



## AUTOMOTIVE

Simple tool block for multiple turning and chamfering.



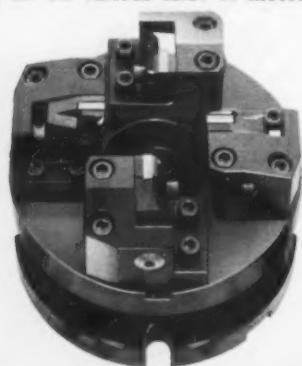
## HYDRAULIC VALVES

Interchangeable preset blocks and cartridges face ends of all valve sizes.



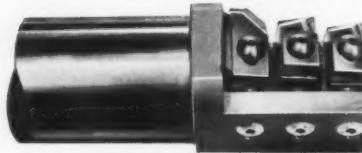
## ELECTRIC MOTORS

Bores and faces all bearings, chamfers OD, ID on various sizes of motors.



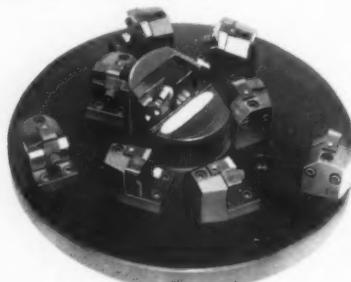
## STEERING ASSEMBLIES

Hollow mill turns ends of control arm shafts.



## AIRCRAFT ENGINES

Simple boring bars perform multiple boring and chamfering.



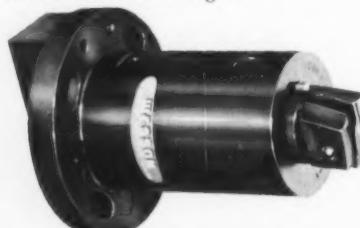
## CLUTCH HOUSING

Bores and faces clutch housing of cast aluminum. Facing units have special cartridges.



## BRAKE DRUMS

This boring tool R & F bores brake drums with 8 cartridges.



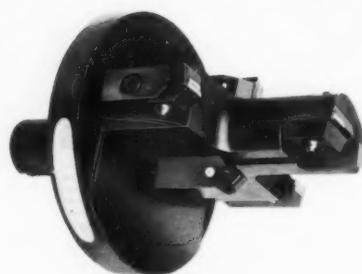
## ALUMINUM SLABS

Milling cutter units to closely control face run-out in slab milling of aluminum ingots.



## CONNECTING RODS

Rough and finish bores big ends of rods. Three cartridges per diameter simultaneously adjustable.



## HOISTS

Semi-finish bores, chamfers end and faces flange in one operation on aluminum hoist housing.



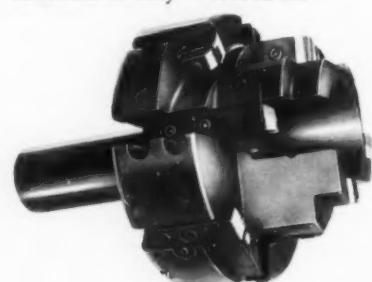
## TRACTORS

Rough bores, grooves, chamfers both ends and finish bores collar coupling.



## ROAD BUILDING EQUIPMENT

R & F connecting rods to a diameter tolerance of only  $\pm 0.0002$  in.



## CONVERTER

Bores, counterbores, turns ID of hub, triple-faces and double-chamfers converter housing.

**WESSON COMPANY, DEPT. AD**  
1220 Woodward Heights Blvd., Detroit 20, Mich.  
**IN CANADA:**  
**WESSON CUTTING TOOLS, LTD.**  
93 Judge Road, Toronto 18, Ontario

Every possible element of business ingenuity must be used to run a manufacturing plant at a profit.

Amongst other things, modern machines are available to help maintain a profit. But it takes more than modern machines and methods. It takes, along with other considerations, scientific machinery replacement programs, executed by forward thinking management men. These men have discovered and use formal work sheets which guide them into full and orderly consideration of all factors necessary to profitable replacements.

See how other prominent manufacturers analyze machinery and equipment purchases. Write to any one of the companies in the Rockford Insert Group for a booklet, "Machinery Replacement Programs."

Pursuit  
of Profit  
in

## Manufacturing

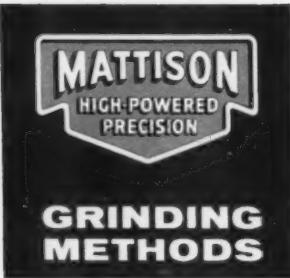
November, 1960

**Rockford  
Insert  
Group**

Keep gathering  
metal-working  
production  
ideas... be well  
informed when you  
replace machinery.

THE  
**ROCKFORD**  
INSERT GROUP

Manufacturers of  
Metal Working Machinery



# Conveyorized grinder finishes honeycomb, large or small parts...accurately, fast

## Production thickness tolerances of $\pm .001"$ held with rigid grinding head

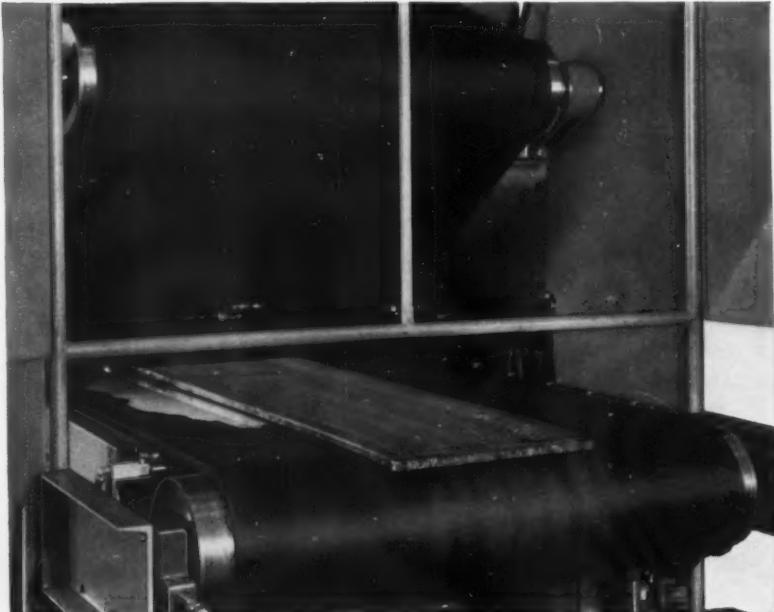
Here's a new way to save on finishing costs for honeycomb, sheet stock, and similar high-production flatwork requiring critical thickness tolerances.

The new Mattison No. 458 conveyorized abrasive belt grinding machine, which combines diamond head design and high horsepower on the belt drive, permits faster stock removal than conventional methods. Thousands of man-hours can be saved in grinding, polishing, and part-handling—thickness tolerances can be held easily to within  $\pm .001"$ , even on large work.

### Conveyor carries work to contact roll at 6 to 60 ft per minute

Small parts may be ground at high production rates by utilizing full conveyor width. Work is held on the rubber-covered conveyor with constant support through the contact area, thus eliminating pinch roll pitch limitations. Conveyors with 36, 48, or 72 in. widths travel at variable speeds to meet individual grinding or polishing requirements. Positive coolant control is optional.

Separation of the contacting and driving rolls prevents transfer of motor pulsations to surface finish. Four rollers in the diamond-shaped head continuously "flex" the abrasive belt to keep it clean, cool, and free-cutting. One roll aligns the belt, one drives it, and another supplies the grinding pressure. The fourth is an idler that provides additional flexing of the belt to prevent loading and assure positive stock removal. Results—longer belt life and finer finishes.



**Mattison No. 458 conveyorized grinder cuts costs with fast finishing of honeycomb, sheet stock, motor laminations, and similar small flatwork requiring precise dimensional control.**

### Flat angle of abrasive contact produces superior scratch pattern

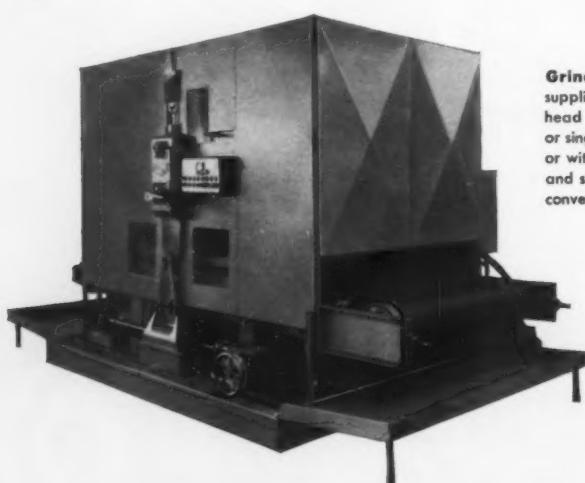
Use of four rollers avoids "wrapping" of the belt on the contact roll. The resulting flat angle of attack permits the belt to conform more closely to the uneven surfaces

of the sheet. This produces a superior scratch pattern and high finishes on sheet stock or parts.

Equal grinding pressure adjustment is assured across the entire width of belt because the table is counterbalanced at each corner by air cylinders—fed up into the contact roll by means of six precision screws. Actuation of the screws is precisely synchronized from a common drive.

Table rapid traverse up and down may be controlled by pushbutton or manual handwheel. Choice of automatic up-feed rates from  $.0002"$  to  $.005"$  per impulse are available to compensate for belt wear and control accuracy of stock removal.

If you are searching for a more successful method of accurate, fast finishing on small flatwork, contact your Mattison representative or write to the factory direct for complete details on the No. 458 conveyorized grinder.



**Grinder can be supplied with a single head for reciprocal or single-pass grinding, or with multiheads and straight-through conveyor.**

**MATTISON MACHINE WORKS**  
Rockford, Illinois Phone WOODLAND 2-5521



**HIGH-POWERED  
PRECISION  
SURFACE GRINDERS**



Machinery, November, 1960

CENTER OF MACHINE-TOOL EXCELLENCE

**ROCKFORD, ILLINOIS, U.S.A.**

## Now . . . 3½" Capacity With This New Greenlee

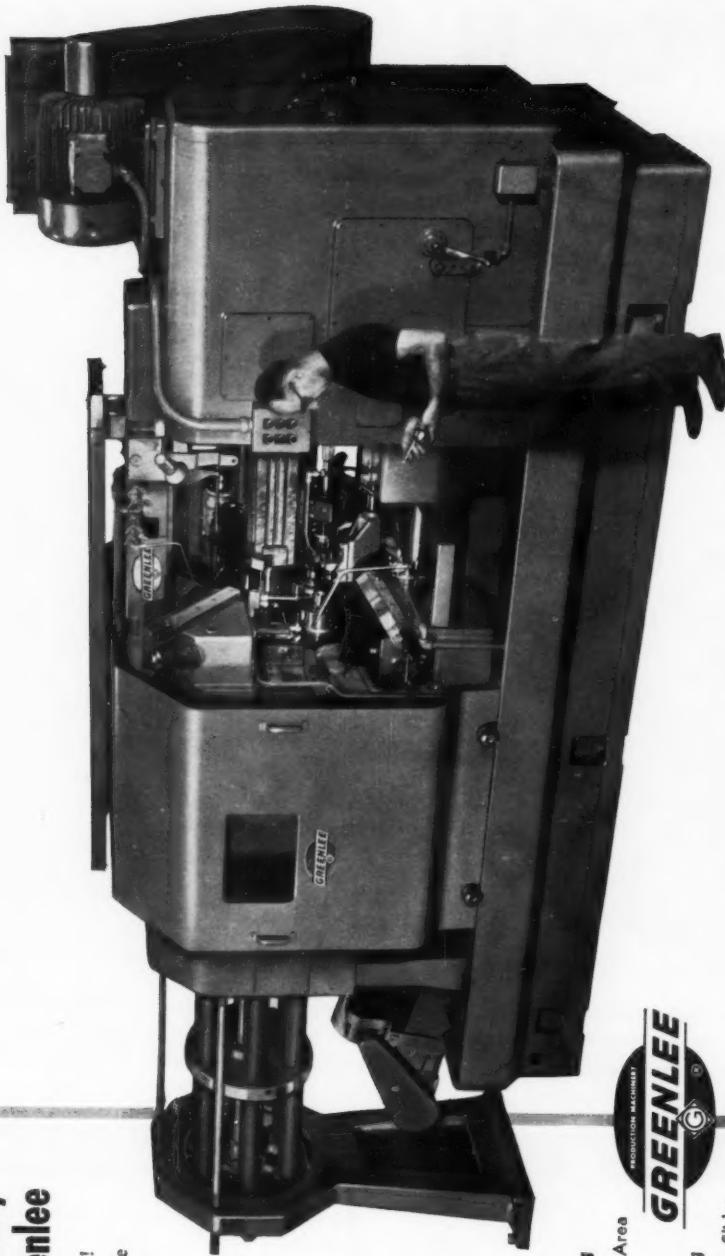
Biggest of the Greenlee Bar Automatics!

This new 3½" — 6 spindle model offers the most outstanding advantages in the field. It is exceptionally versatile. It offers well-known Greenlee dependability.

Like all Greenlee Automatics it has independent, cam-operated cross slides and a wide-open tooling area. Greater flexibility, accuracy and productivity are built into this big, powerful

Greenlee Automatic. Check these outstanding advantages:

- Permanently Aligned Spindle Carrier
- Positive, High-Speed Carrier Indexing
- Wide-Open, Easily Reached Tooling Area
- Sturdy, Cam-Feed Main Tool Slide
- Interchangeable Cross Slide Camming
- Micrometer Adjustment On All Cross Slides
- Rapid-Shift, Dual-Range Speed and Feed Gears
- Built-in Lead Screw Threading Feed and Drive



**GREENLEE<sup>®</sup>** BROS.  
& CO.  
1944 MASON AVENUE, ROCKFORD, ILL.

Other Greenlee 6 Spindle Bar Automatics  
are offered in 1", 1½", 2", and 2½" capacities.

TRANSFER MACHINES • SPECIAL MACHINES • SIX AND FOUR SPINDLE AUTOMATICS • TRIM PRESSES • DIE CASTING MACHINES • WOODWORKING MACHINES AND TOOLS • HYDRAULIC AND HAND TOOLS

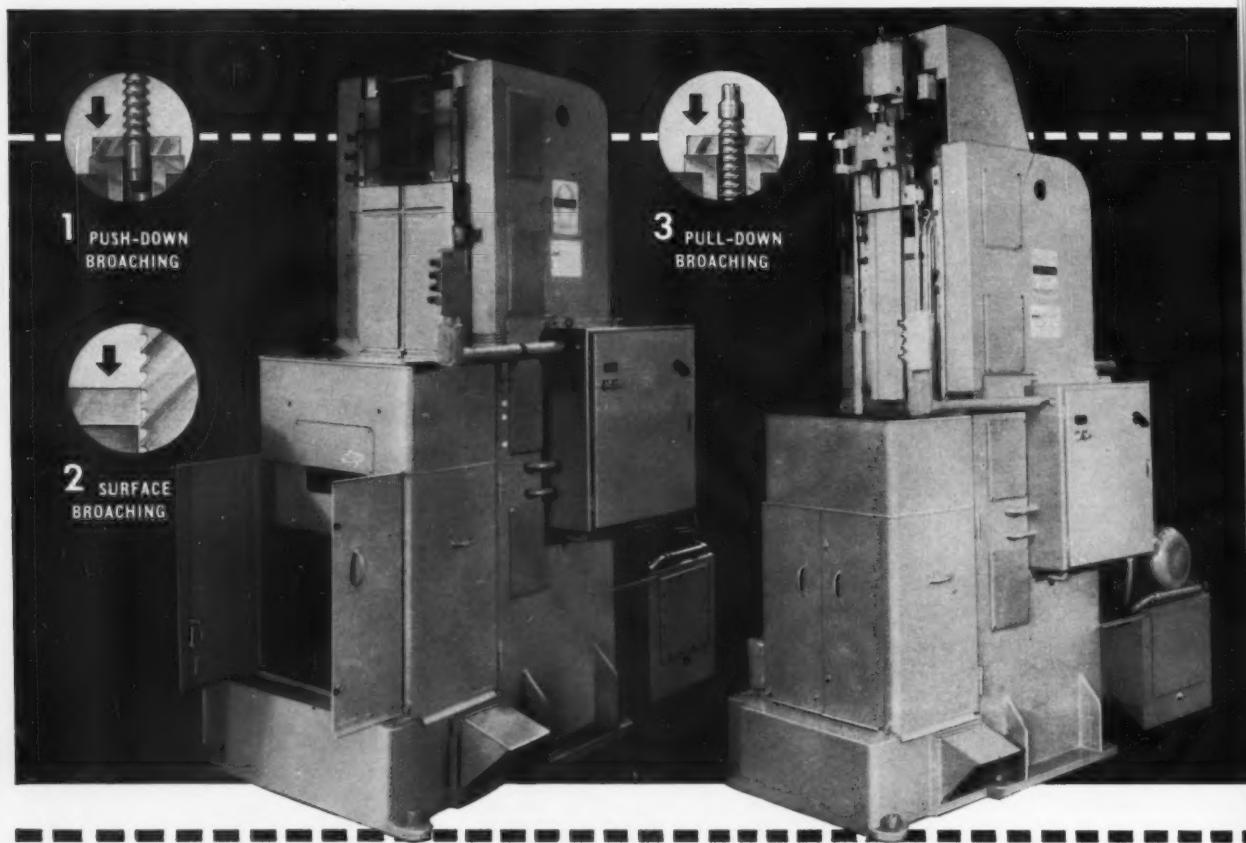
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CITY OF MACHINE-TOOL SPECIALISTS

**ROCKFORD, ILLINOIS, U.S.A.**

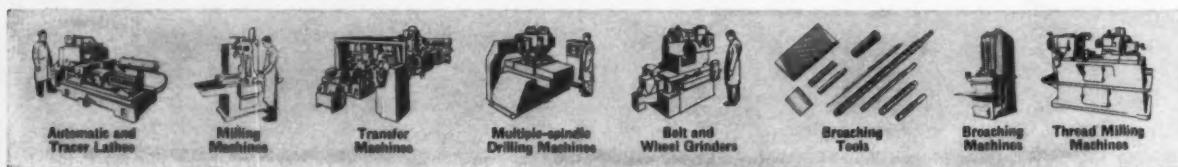


# 4-WAY CONVERTIBLE



New Sundstrand-American vertical broaching machines provide built-in protection against obsolescence due to changing work requirements. They can be converted at moderate cost in a matter of hours from any one arrangement to another — push-down, pull-down, pull-up, or surface broaching.

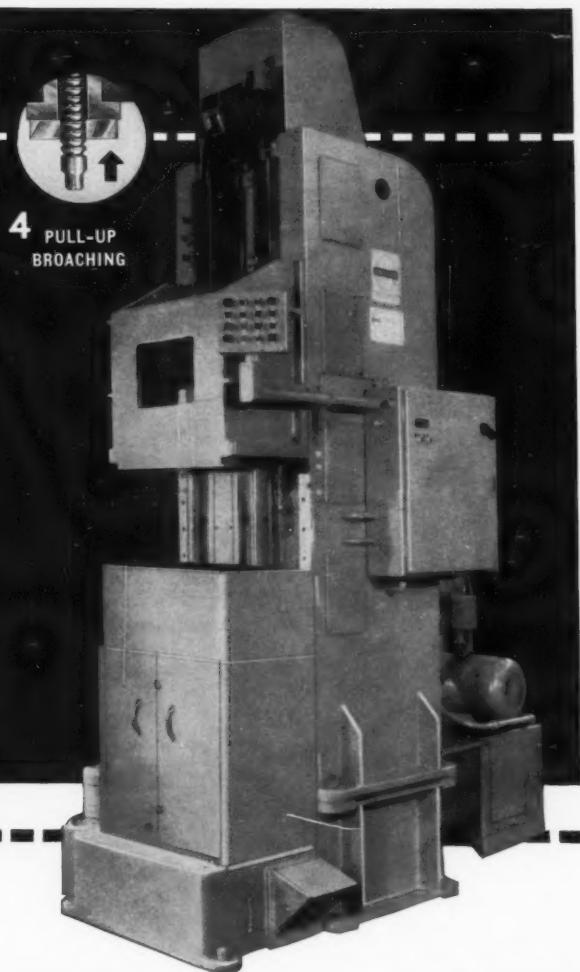
TYPE OF MACHINE	BASIC MACHINE UNITS Standard for Each Stroke Tonnage Size				CONVERSION ASSEMBLIES REQUIRED		
	COLUMN	SLIDE	HYDRAULIC CYLINDER	HYDRAULIC POWER UNIT	PUSH-PULL LUG	HYDRAULIC BROACH RETRIEVER	SUB-BASE
PUSH DOWN							
SURFACE							
PULL DOWN							
PULL UP							



Machinery, November, 1960

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

# BROACHING MACHINES



... new Sundstrand-American machines can be converted at moderate cost to meet any vertical broaching requirement

Each machine consists of the same four basic units: 1. machine column with hardened-and-ground rectangular ways, main cylinder mounting, and chip base; 2. broaching slide; 3. hydraulic cylinder unit; 4. hydraulic power unit. These four elements, together with interchangeable conversion assemblies shown in the chart below, make possible the simplified change-over.

Three types of worktables — fixed, sliding, and tilting — are available for surface broaching operations. The fixed table also is used for internal pull-down, pull-up, and push-down work.

The new machines are built in single- and dual-ram models, the dual units having a wider column which carries two complete main cylinders, guide ways, slides, and tables.

Both types are built in 5, 10, 15, 25, 40, and 50-ton capacities, with strokes from 30" to 90", depending on tonnage — 22 stroke-tonnage combinations in all. All operations are from a pushbutton station.

A wide variety of pull heads, in addition to Sundstrand-Engineered fixturing and broaching tools are available to insure maximum productivity on any broaching arrangement.

*For complete information,  
write for new Bulletin 621.*



CONVERSION ASSEMBLIES REQUIRED



FIXED TABLE



SLIDING TABLE



TLTING TABLE

SUNDSTRAND-AMERICAN BROACHING EQUIPMENT

**SUNDSTRAND MACHINE TOOL**

BELVIDERE, ILLINOIS • DIVISION OF SUNDSTRAND CORPORATION



# Why every metalworking plant should own a Barber-Colman numerically controlled lathe

This 16-inch swing lathe combines greatly simplified numerical control . . . low cost . . . and versatility to fit any shop that has short-run jobs, either step or taper turning. It is a completely flexible general-purpose machine—designed for rapid change-over and economical job-shop operation.

The Tape-r-guide, as you can see it at bottom of page, is one complete package. There is no freestanding console. The reader is in the headstock, and all other controls are in the rear panel.

Here is a dramatically different approach to numerical control . . . one that operates without intricate memory units . . . one that is simple enough to gladden the heart of every maintenance man and controller. For example, there are only two

thyatron tubes in the Tape-r-guide, and these are of a long-life, extra-duty type, guaranteed for two years. Except for these, and some common solenoids and relays, controls consist entirely of solid-state circuits. On-off devices have been used wherever possible. There is no quantitative requirement on electrical functions. There is no critical voltage level that would permit an off-size dimension and a scrapped piecepart. Basically mechanical actuation means you have a lathe that is easy to live with, has more time to cut metal. Despite its extreme simplicity, Barber-Colman Tape-r-guide pro-

vides every one of the operating, control, and setup advantages you normally expect from the more complex tape-control systems. That's because it is designed specifically for its application and is incorporated right into the lathe. Handwheels and manual control levers are used for setup only.

#### Both axes always under direct control

All stop-start, positioning, speed adjustment, and feed change functions are controlled automatically from eight-channel binary code tape. Simple radii may be formed under tape control, using standard single-point tools. Both axes are continuously under precise and *direct* control. By



Machinery, November, 1960



MACHINES DESIGNED TO MEET YOUR NEEDS

**ROCKFORD, ILLINOIS, U.S.A.**



**It pays for itself quickly on short-run step and taper turning jobs. You cannot buy the same capabilities in other lathes for anywhere near the price. And it's the simplest numerically controlled lathe to program, set up, operate, and maintain.**

feeding both carriage and cross slide, the machine will cut accurate, discrete tapers having included angles from  $2^{\circ}$  to  $172^{\circ}$ . There is no feedback. This machine will do your jobs faster than a tracer lathe because it relieves the operator more completely of size control, machine speed, operating, and setup responsibilities. Setup is faster and foolproof. Tools are preset off the machine for fast changing. Now, you can eliminate the cost and inflexibility of templates and special tooling. Job programming and tape punching can be done for a small fraction of the cost of making templates. In short, the Tape-r-guide gives you more control and greater production than a tracer lathe—yet amazing simplicity takes it out of the price class of most numerically controlled machine tools.

System resolution is within  $\pm .001"$  on diameter and length, but the machine itself is mechanically capable of even finer work. You can turn chamfers without special tools—perform cutoff, boring, drilling, and reaming operations, as well as internal and external step-turning. Anti-friction ball screws and nuts increase sensitivity of the carriage and cross slide—you get fast, accurate response to every command.

#### **Even the coding is simple**

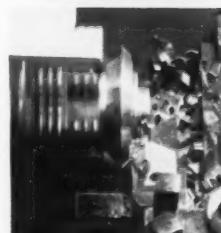
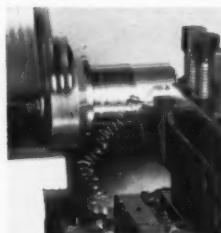
The Barber-Colman coding system is simple, which saves time in data processing. It is based on the binary system of numbers, designed expressly for engine lathe operations. There are only five alpha-type designations for the commands. Just one row on the tape completes an axis command . . . only a few rows are

required for each complete command sequence.

Numerical control begins at the first point of operation of the tool, rather than from an absolute zero point. After reading the command, the machine executes instantly. Elimination of intermediate data storage reduces equipment cost and permits more efficient lathe design.

The Tape-r-guide produces fine finishes and precision tolerances—fast. It has large swing capacities (16" and 20"), infinite selection of spindle speeds to 1200 rpm, rapid traverse of the cross slide and carriage, and rugged frame castings made of dense Meehanite metal.

Ask your Barber-Colman representative for details on the "universal tooling" economics of Tape-r-guide numerical control.

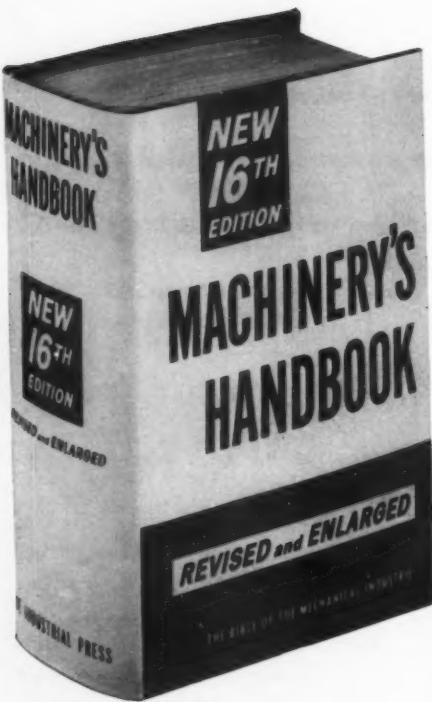


**Barber-Colman Company**



112 Loomis Street, Rockford Illinois





# THE MOST COMPREHENSIVE, UP-TO-DATE METALWORKING AND DESIGN HANDBOOK YOU CAN OWN!

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192 pages added in the 16th Edition

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Whether you are a supervisor, foreman, inspector, toolmaker, machinist, student, or apprentice, you need an accurate, easy-to-use, up-to-date source of specific metalworking information.

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saving time, work and money for its users. No wonder over a million and a quarter copies have been sold! No wonder it has earned the reputation as "the bible of the mechanical industries"!

And now, in this greatly revised and enlarged edition, you get all the latest and best principles, practices, specifications, standards and other useful working data. The 16th Edition reflects the tremendous advances the metalworking industries have made; and it gives you the information you need to keep pace with that progress. The comprehensive cross-index and the convenient thumb-index will help you find any one of the subjects in seconds!

Dependable . . . accurate . . . authoritative . . . comprehensive, the new 16th Edition is the largest and best MACHINERY'S HANDBOOK ever published. Yet in physical size it is still a true HAND-book, compact and easy to use. It is the one book you will refer to again and again for the incomparable wealth of information it provides. Send for your copy today!

**2104 Pages**

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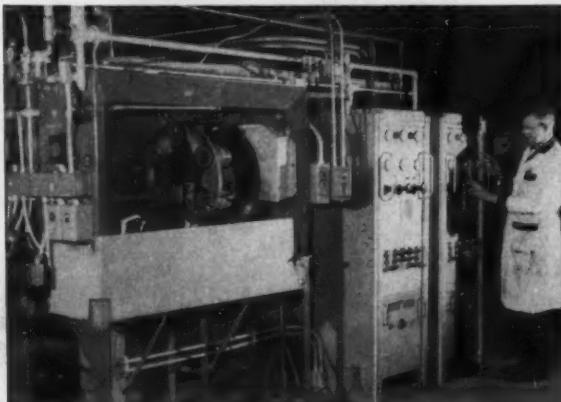
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# *Flame sprayed metal increases wear resistance better than 10 times*

## **AIDS WEIGHT REDUCTION**



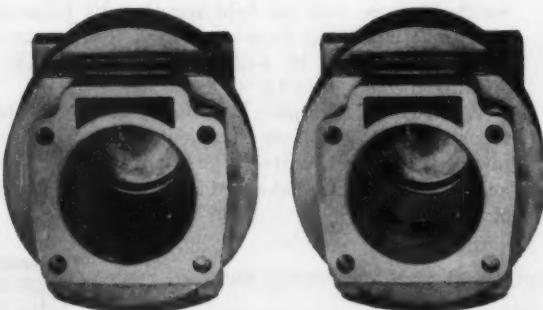
Automatic setup for metallizing inner walls of aluminum cylinders used in lightweight gasoline engines. Cabinet in foreground houses six-station rotary setup; automatic control panels are at right.

Many methods, including cast-iron cylinder liners and chrome plating, have been tested for wear resistance in lightweight gasoline engine blocks of aluminum.

Best of these methods experienced breakdowns in less than 400 hours. Now they are metallized with METCO Sprabond (molybdenum alloy) as a bonding agent, followed by a coating of sprayed steel alloy.

Test runs of over 4,000 hours show little or no wear of the metallized surface. Finish thickness is .007"; weight—a few grams. Cast-iron liners weighed almost  $\frac{1}{2}$  pound.

Cylinder at left machined ready for flame spraying; one at right has been metallized and honed finished.



Closeup of automatic six-station rotary setup. Cylinders are individually rotated at 150 rpm. Cylinder is loaded on table at Station 1, moved through Stations 2 and 3 for pre-heating by torch. At Station 4, bonding coat is applied by the gun nozzle which feeds into the rotating cylinder. Low alloy steel is applied at Station 5 and cylinder cools at Station 6. Cylinder walls are finished by honing.

## New engineering data bulletin

Bulletin 136B—The METCO Flame Spraying Processes, provides basic engineering and application data on flame sprayed coatings of metals, ceramics, carbides and other high melting point materials. 16 pages. Send coupon for free copy.

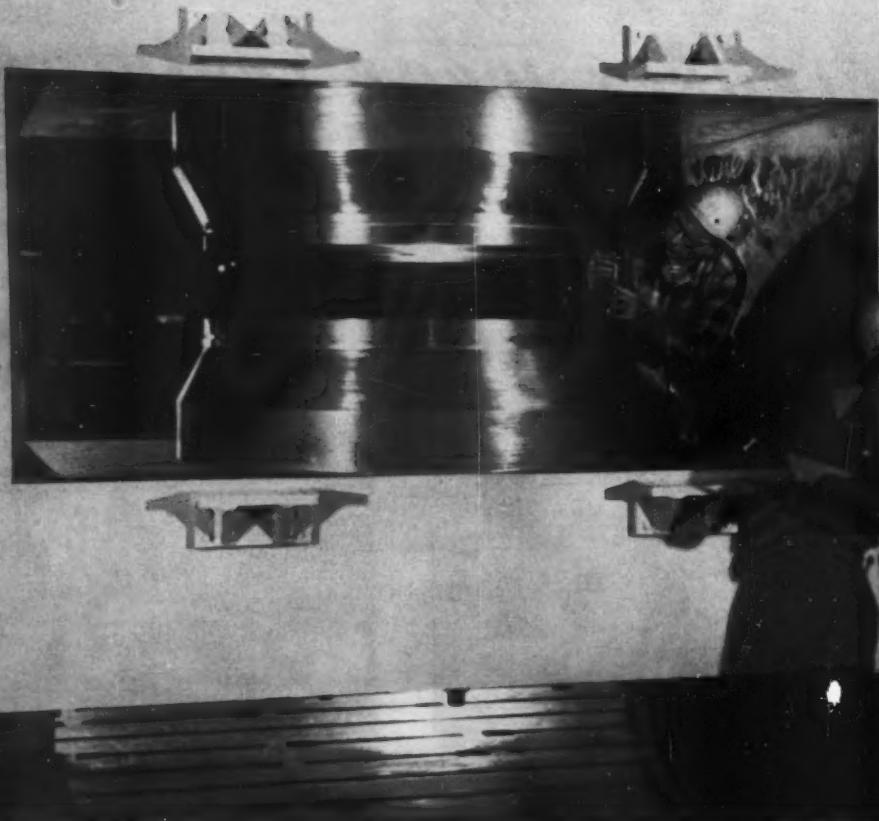
\*\*\*\*\*

**METCO INC.**  
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Don Watson  
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For more data circle this page number on card at back of book



BETHLEHEM INSPECTORS measure the magnetic gap between the pole pieces of a magnet for the new University of Colorado cyclotron.

## 85-ton magnet for new research cyclotron forged, machined, and assembled by Bethlehem

The core of a new research cyclotron to be installed by the University of Colorado at Boulder is that 85-ton magnet you see above.

To make this magnet accurate and controllable, Bethlehem had to finish the huge magnet parts to thousandths and to micro-inch finishes. Most critical were the pole tips, which had to be machined to parallelism within 0.004 in. on the 52-in. diameter. They were machined a few thousandths oversize, then the final fitting and machining was done.

The forged pole pieces are tapered on the sides from 59 to 52 in. on the diameter, and are 14.4 in. thick.

The yoke members, four of them, were forged in a 7500-ton hydraulic press, then machined to 250-micro-in. with mating surfaces finished to 125 micro-in. They weigh 73 tons, and are held together by large dowel pins and studs. They form a rectangular yoke assembly 142½ in. long, 60 in. wide, and 88½ in. high. The opening measures 96 by 42 in.

When completed, the Boulder cyclotron, a strong-focusing type, will have a capacity range of 10 to 30 million electron volts. The electrons will strike a target when their final speed is built up to  $\frac{1}{5}$  the speed of light.

Bethlehem Steel Company, Bethlehem, Pa. Export Sales: Bethlehem Steel Export Corporation

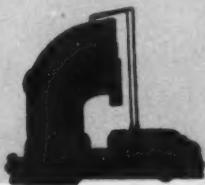
**BETHLEHEM STEEL**



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All facilities of the Lapointe plant in Hudson, Mass., including engineering and service personnel, are at the disposal of this line.

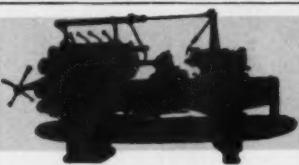


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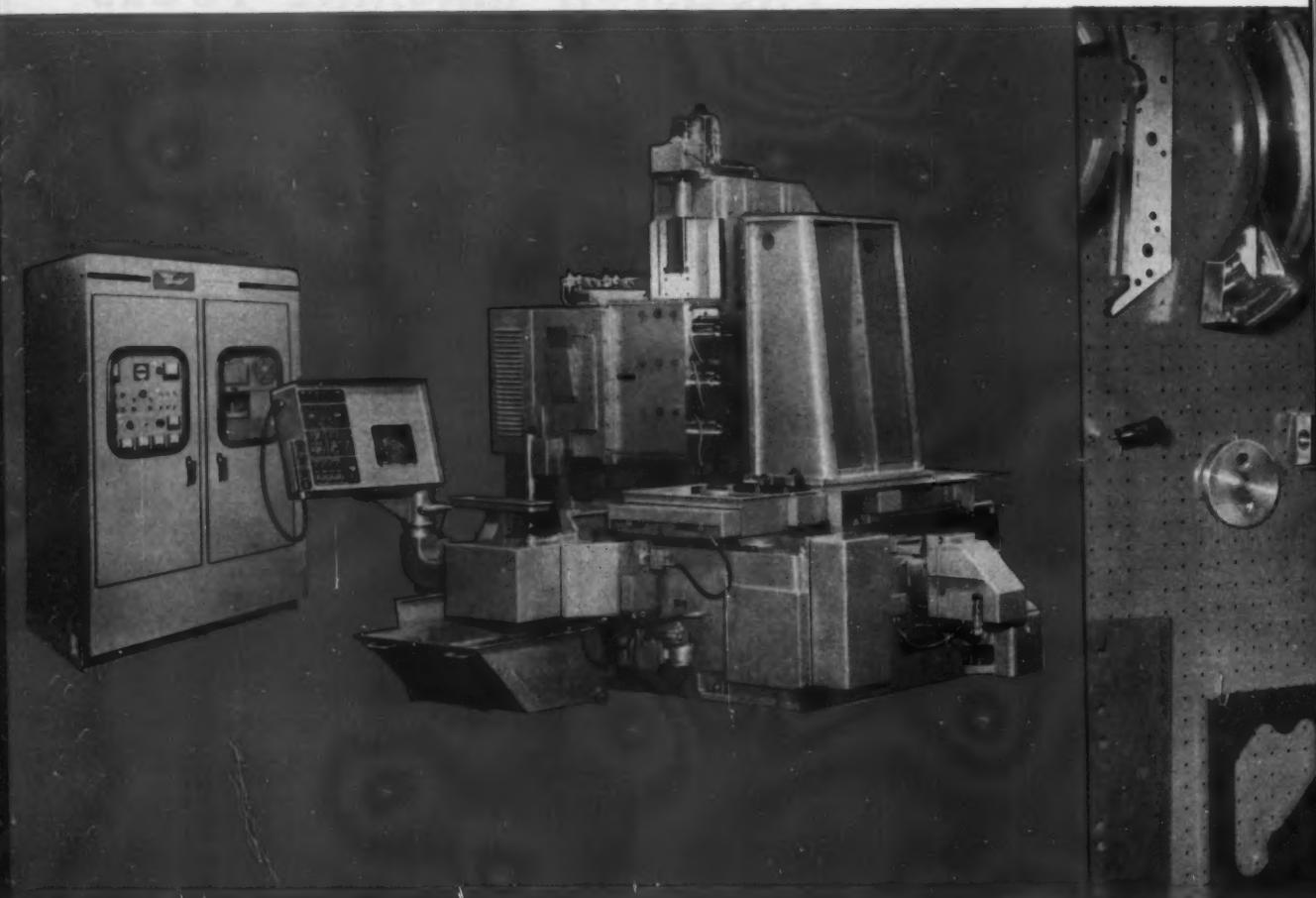
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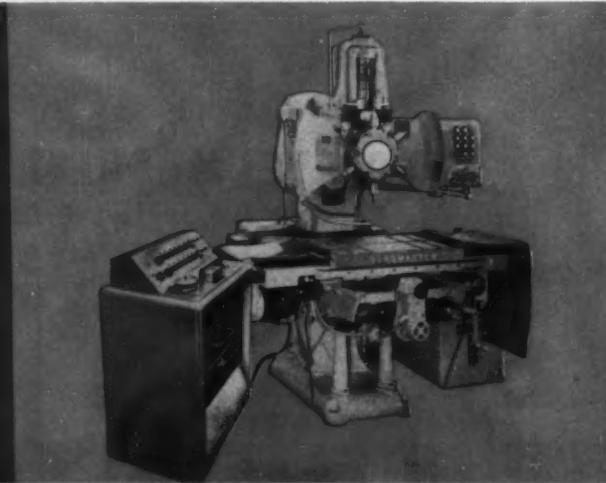
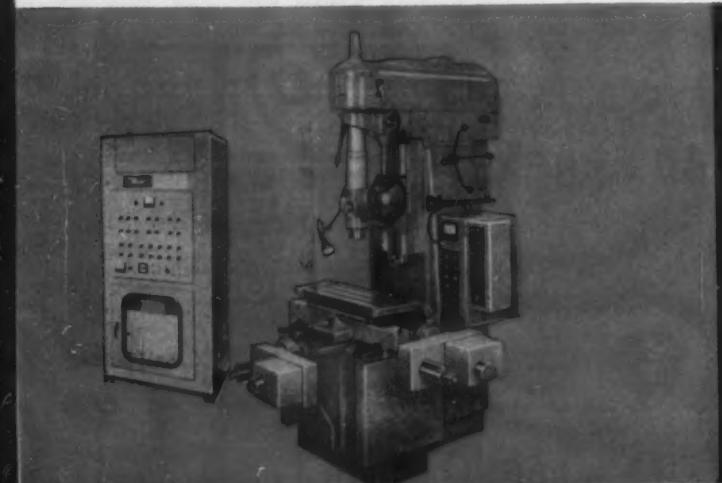


**DYNAPATH-23 NUMERICAL CONTOURING CONTROL.** Featuring *Circular Interpolation* to permit the close-tolerance machining of arcs and circles, as well as straight lines, with a minimum of input data. Offers 0.0002-inch resolution on 2, 3, or more axes of control. Each application individually engineered for the best possible combination of machine tool and control unit.

**DYNAPoint-22 NUMERICAL POSITIONING CONTROL.** Provides the finest electronic resolution available anywhere—0.000010" for jig borer accuracies within 0.0001" on finished parts. Uses 8-channel binary-coded decimal tape format—compatible with other N. C. units and with standard tape preparation equipment.

**TREMENDOUS VARIETY** of parts machined with Bendix numerical control shown here. Parts range from complex missile components to simple but extremely accurate cams.

**FERRANTI FP-22 NUMERICAL POSITIONING CONTROL SYSTEM.** Floating zero for fast, easy set-up and low-cost tooling. Dial input provides manual operation flexibility. Wear and loss of accuracy eliminated because there are no contacting parts in measuring units.



# OF NUMERICAL CONTROLS



New, completely transistorized POSITIONING and CONTOURING units provide greater reliability, lower operating costs and made-to-order accuracy.

Tested and proven in scores of installations, over thousands of productive hours, Bendix numerically controlled contouring systems have become recognized as the finest. Based on this solid history of achievement, The Bendix Corporation now introduces its second generation control systems, the DynaPath-20 Series Numerical Contouring Controls, and the DynaPoint-20 Series Numerical Positioning Controls.

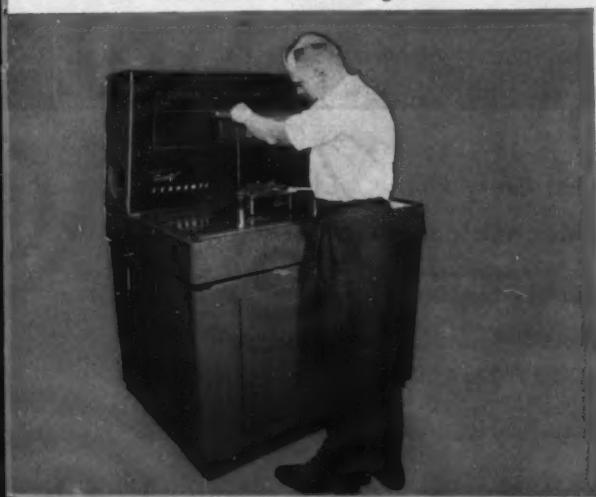
To further extend its broad coverage of the numerical control field, Bendix has obtained exclusive rights to distribute the Ferranti tape controlled positioning units and Ferranti's

unique coordinate measuring machine.

Bendix backs up the most complete line of numerical control equipment with the best and most complete service organization in this country. From application engineering through tape preparation, customer training and field service, Bendix has had more teamwork experience than has any other electronic controls manufacturer in the field.

Only at Bendix can the machine tool builder and user find everything he needs for numerically controlled manufacturing. Why not investigate Bendix **PACKAGED PRODUCTIVITY** today.

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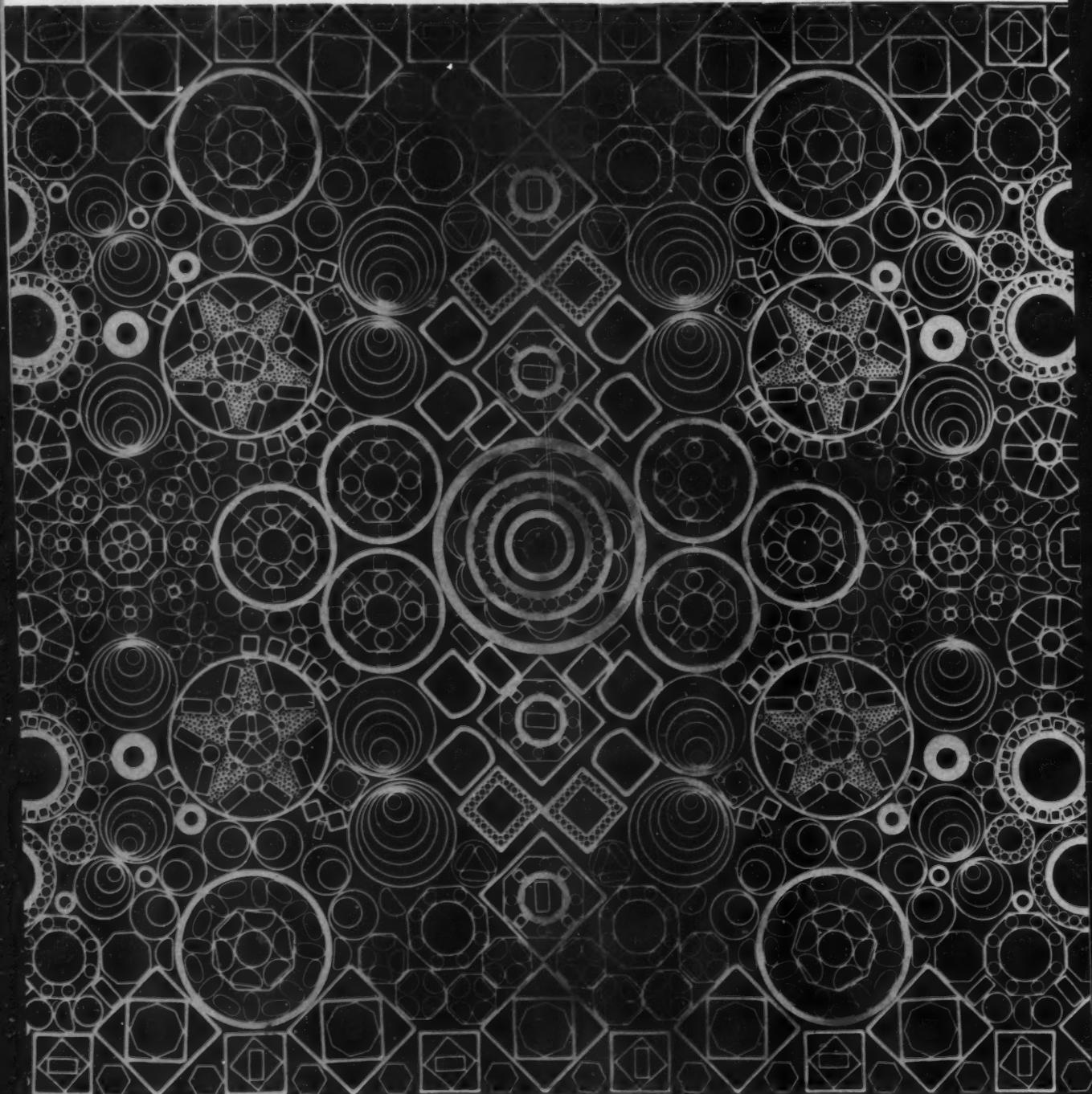
## Industrial Controls Section

21820 Wyoming, Detroit 37, Michigan

For additional information on Bendix Numerical Control and Measuring Equipment, please write to Bendix at the above address.



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**Seamless Steel Tubing** comes in almost every shape and size,  
that is, if it's **USS National Seamless Mechanical Tubing**.

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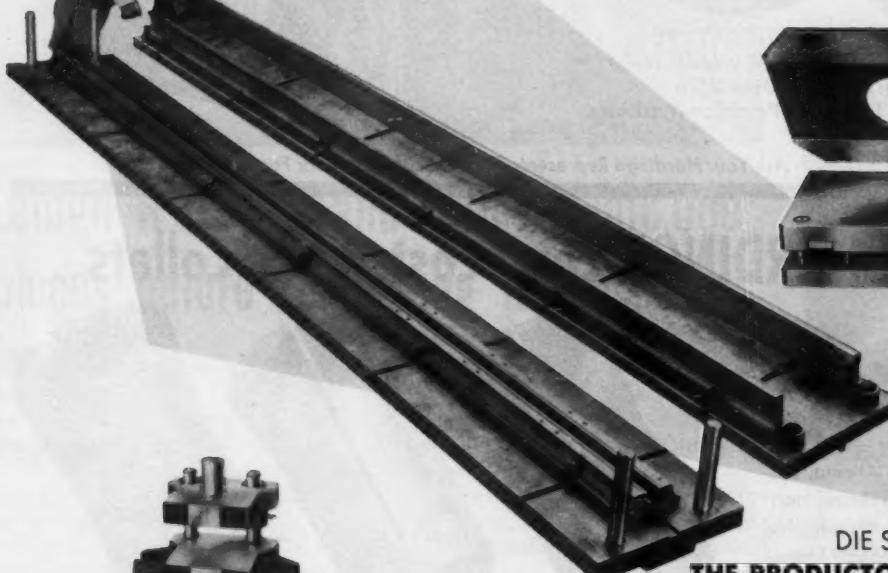
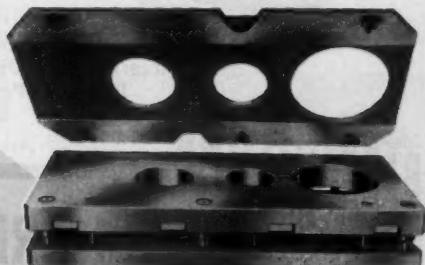
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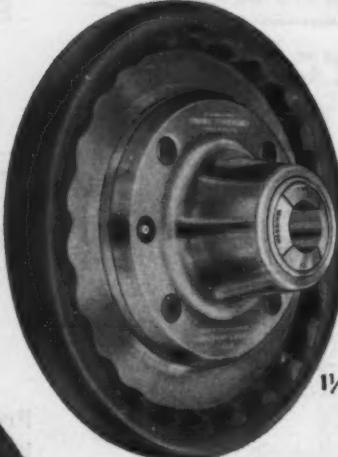
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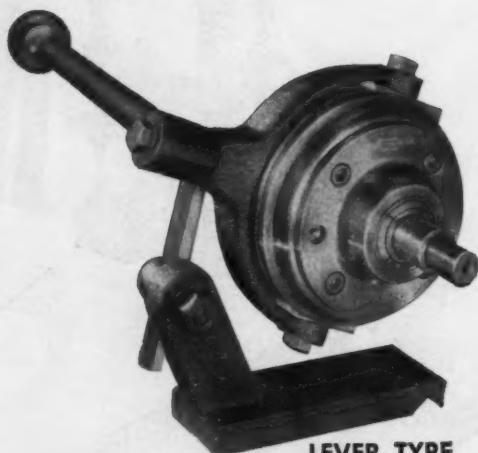
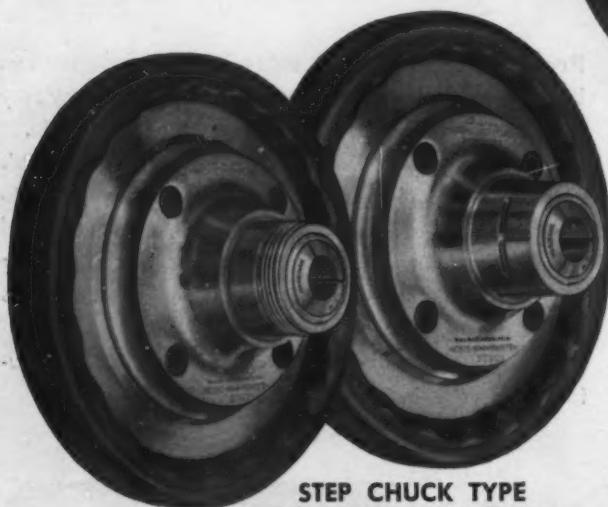
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**STEP CHUCK TYPE**  
Takes Standard Spindle Nose  
Accessories As Used With  
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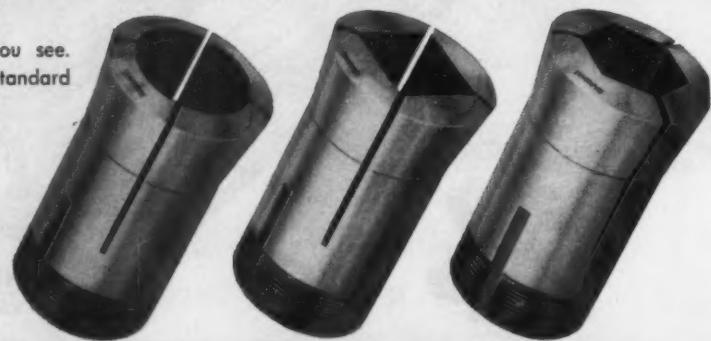
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Records show that 82% of all sizes used are standard  
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Collet stocks are available in Atlanta, Boston,  
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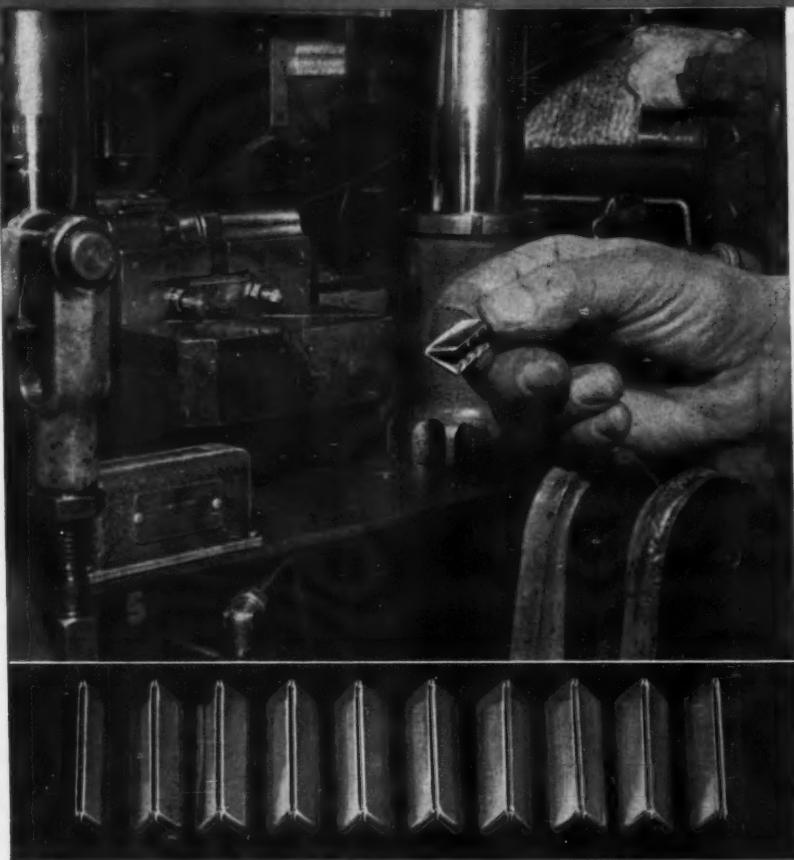


# Tool Steel Topics



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Sales: Bethlehem Steel Export Corporation



## BETHLEHEM TOOL STEEL ENGINEER SAYS:



### *Blind Holes Can Cause Plenty of Trouble*

Unless one uses great care, blind holes can cause a lot of trouble when heat-treating tools. Holes for studs or dowel pins are typical of the blind holes which, as a rule, are paid little attention. Exposing blind holes to liquid quenching produces extremely high internal stresses, which can lead to cracking of the tool, either during heat-treatment or in service.

If it is not necessary for blind holes to be hard internally, these difficulties can be avoided by packing the holes prior to the quench, using clay, asbestos rope, steel wool, or a steel plug.

Blind holes are particularly objectionable if they must be uniformly hard on the inside surface. The only way to meet this requirement consistently is to select a grade of air-hardening tool steel.



## Lehigh H blanks and forms 1,000,000 pieces before redressing is necessary

Using a die of Bethlehem Lehigh H tool steel, Sobel Metal Products Co., Easton, Pa., produced this nickel-silver belt accessory, of the type used with army uniforms, at the rate of about 1,000,000 pieces before redressing was necessary. Blanking and forming .020-in. metal, the die was hardened to Rockwell C60-61. One of the requirements of the order was that no marking was permitted on the finished part.

Lehigh H (AISI D-2) is excellent tool steel for jobs like this. Not only is it the leader in machinability among

the high-carbon, high-chromium tool steels sold today—it also has improved wear-resistance because its vanadium content has been increased to 1 pct.

As the result of a new manufacturing process, Lehigh H has improved carbide distribution and increased center density. It also has minimum distortion during heat-treatment.

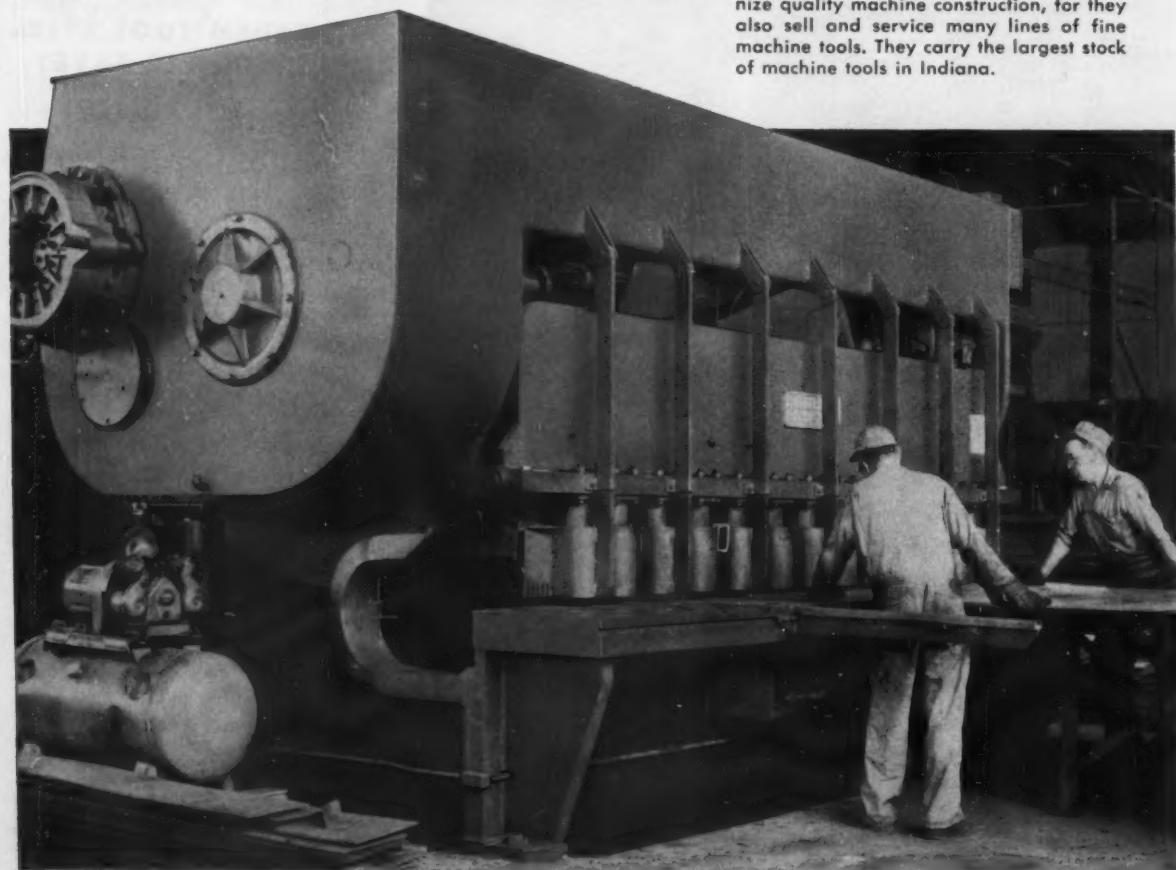
If you want unexcelled machinability, excellent wear-resistance, and plenty of dependability, Lehigh H is your answer. See your Bethlehem tool steel distributor for prompt delivery.

### **Be Sure to Try Red Sabre Tool Bits**

You're sure of economical cutting when you use Bethlehem Red Sabre Tool Bits, regardless of the type of application. Red Sabre is a super high-speed steel, with about 1.50 carbon, 12.00 tungsten, 5.00 vanadium, and 5.00 cobalt. The bits have high red-hardness and uniform hardness all the way through, for peak resistance to wear and maximum cutting ability. They come hardened to Rockwell C65.

# STEELWELD SHEAR ENABLES STEEL WAREHOUSE TO PROVIDE DELUXE SERVICE

**Indianapolis Supplier Cuts Plates  
To Suit Customers' Needs EXACTLY**



This Steelweld Shear is much appreciated at the Indianapolis Machinery Co., Inc. And they should be in a position to recognize quality machine construction, for they also sell and service many lines of fine machine tools. They carry the largest stock of machine tools in Indiana.

WITH a Steelweld Pivoted-Blade Shear that has been operated continuously in its steel warehouse since 1953, the Indianapolis Machinery Co., Inc., Indianapolis, furnishes metal cut to exactly meet its customers' requirements.

This usually means thicknesses from  $\frac{3}{16}$  to  $\frac{3}{4}$  inch, widths varying from a few inches to 12 feet and lengths to the maximum available from the mills. The metal may be mild steel, stainless or any of a number of special alloys. Whatever the metal or thickness, the cuts are straight and accurate with negligible burr, because the knife clearance is always adjusted to produce the best results.

Some orders call for strips of type 304 stainless,  $\frac{5}{16}$  and  $\frac{3}{8}$  inch thick by  $1\frac{1}{4}$  and  $2\frac{1}{4}$  inch wide. Others call for hard abrasive-resisting steel in strips  $\frac{3}{8}$  by 2 and  $2\frac{1}{4}$  inches. Because of the shear's very low knife rake angle, such items are made with extremely little twist, camber and bow.

The air-operated clutch and brake have proven phenomenal by customary shear standards. Despite

the tens of thousands of times the clutch and brake have opened and closed in making as many cuts over the years, the original linings are still in use. The action continues snappy and positive. The machine has its own air compressor mounted on one end.

Considering the large volume of shearing work done, the knife wear has been long and satisfactory. Knife grindings have been at least a year or more apart. This is attributed to not only the quality of the knives, but to the low rake at which they operate and also the correct knife clearance used for all cutting.

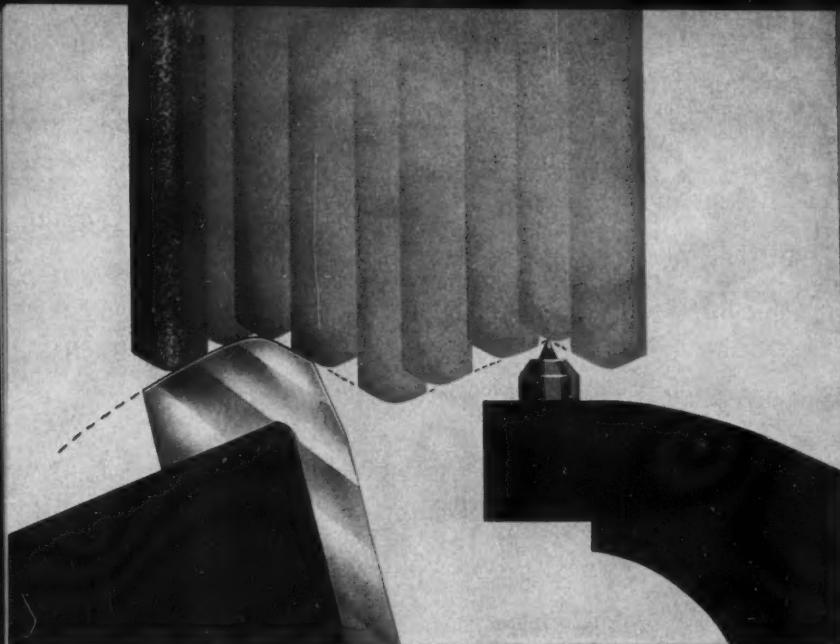
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**PIVOTED  
BLADE** **SHEARS**



Steelweld Machinery includes: Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

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## A "TRIPLE CHECK" FOR FACE MILLS

To obtain peak performance in your face milling operations you must be certain to achieve (1) maximum cutter life, (2) lowest possible micro-inch reading on the surface being milled and (3) the most economical method of sharpening the cutter.

Check your performance to see if you are using all three of the following helpful hints:

1. Maximum cutter life requires the elimination of all sharp corner angles which are normally subject to early breakdown. The Oliver face mill grinder automatically incorporates a corner radius between the face and the lead angle thus correcting this situation. A test grind on your face mill will show a substantial increase in pieces milled per grind.
2. For the finest finish a radius should be used on the face rather than a straight line grind. The face radius

### OLIVER'S FACE MILL GRINDER features automatic wheel dressing with every stroke

The drawing above shows the grinding wheel passing over a cutter tooth after being dressed and formed automatically by a fixed diamond. This happens with each stroke of the Oliver automatic face mill grinder. This exclusive Oliver of Adrian feature permits carbide grinding with a silicon carbide wheel. Automatic feed-down accurately compensates for each dressing thus providing a fixed grinding line which insures a minimum of run-out.

The machine automatically indexes the cutter and controls the tooth shape by a simple cam arrangement so that any practical roughing or finishing form can be obtained. Oliver's face mill grinder is hydraulically operated for smooth, fast (4 to 8 times faster per cutter), accurate and trouble-free performance.

In addition to the automatic machine, Oliver also produces a hand operated, heavy duty machine for all types of face mill grinding on coarse and fine pitch cutters from 4" to 24" in diameter. Still a third machine in this general family is the Oliver No. 2 Arc Radius Cutter Grinder for face mills and cutters requiring a radius on the corner.

Oliver will grind face mills on a "no charge" basis as a demonstration of the ability of the machines. We'd like to work with you—write today.



(40° to 100°) eliminates the line contact which is largely responsible for the rougher milled surfaces. Standard cams include this feature automatically on the Oliver machine.

3. Minimum grinding costs require the use of fast, automatic machines capable of using semi-skilled operators. The Oliver face mill grinder provides for complete automatic operation, including the indexing as well as the grinding of the lead angle, corner radius, face, dish and the removal of the soft steel backing on carbide tipped cutters. The automatic up-feed of the cutter is an optional feature.

# OLIVER of ADRIAN

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DRILL GRINDERS AND THINNERS—TOOL AND CUTTER GRINDERS—AUTOMATIC AND MANUAL  
FACE MILL GRINDERS—TOOL BIT GRINDERS—CONTOUR SAWING AND FILEING MACHINES.



## for economical JOB-SHOP RUNS...

The new SIP HYDROPTIC machine is faster in operation and response, more flexible, with greater machining capacity. In using a HYDROPTIC, the unique performance and guaranteed accuracy of positioning ensures economical production of normally expensive job-shop runs.

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- **Mobilization Base Reviewed**
- **NMTBA in Post-Exposition Period**
- **Washington Briefs**



## Keeping up with Washington

Loring F. Overman

**IMPORTANT TASKS** await the two new advisers being lent the BDSA's Metalworking Equipment Division by private industry. (One represents machine tools; the other, industrial furnaces.) Washington hopes they will be of assistance in bringing stability to the metalworking industries. While awaiting confirmation of the appointments of the advisers, BDSA staff people are busy with several approaches to the subject.

### Mobilization Base Reviewed

Already undergoing study is the mobilization base—the nation's machine-readiness for defense production in an emergency. The base is being eyed from two angles: that of its relationship to defense as such, as well as to the economic stability of the machinery industries. The current review is based on the 1953 recommendations of the Vance Committee. That group urged that (1) the mobilization base include well-equipped stand-by production lines, and (2) a strong machine-tool industry be maintained by the combined needs of both business and the military. The goal of stand-by production lines has been deflected somewhat by the introduction of ever-changing nuclear weapons. With some defense areas urging a reassessment of limited-war techniques, the relationship of machine tools to the mobilization base again comes in for examination.

Acting on a brief filed last spring by the National Machine Tool Builders' Association, the Office of Civilian Defense Mobilization has also recommended two reviews affecting the machine-tool industry. The first of these studies involves the import-export status of the industry. BDSA, conducting the study of OCDM, expects to have its conclusions ready by mid-November.

The second OCDM study is concerned with the American industrial economy and its relationship to the machine-tool industry. In an effort to determine whether an accurate evaluation can be made of the factors that influence management to replace machine tools, BDSA is conducting a pilot study through Arthur D. Little, Inc., Cambridge, Mass. BDSA officials have some reservations as to whether the replacement-influencing factors are subject to statistical evaluation, but they promise to broaden the study if the pilot conclusions are sufficiently convincing.

Meanwhile, in a separate study, the Internal Revenue Service has been asked to consider factors other than depreciation in connection with machine-tool replacement. BDSA points out that even if an accelerated depreciation period became allowable, it would permit recovery of only the cost of initial acquisition. Replacement, on the other hand, usually involves outlay far beyond the amortization fund.

### BDSA Unit an Award Winner

If the Metalworking Equipment Division is as successful in solving the machine-tool problem as it was in a recent BDSA contest, all will be well. The unit, of which Philip Bennett is director, was the winner among twenty-four BDSA divisions competing for the Best Suggestion Award offered staff members to increase operating efficiency. The award was first offered in July of this year.

### NMTBA in Post-Exposition Period

Officials and staff of the National Machine Tool Builders' Association were evaluating its Machine Tool Exposition enthusiastically. NMTBA's Ludlow King reported that members were well satisfied with results of the show, as evidenced by the number and caliber of visitors and inquiries. Meanwhile, the association is encouraging steps to complete the industry-government-user groups being formed to urge standardization of machine-tool nomenclature, dimensions, and other items.

### Steel May Signal Upturn

Pending results of any actions which BDSA may take, Washington is looking to the steel industry for the first signs that heavy industry may be on the mend. A White House parley on steel immediately following Election Day is in prospect. The purpose would be to encourage production and attempt to prevent strikes.

### Washington Briefs

Space program costs will rise from the present \$915,000,000 annual figure to \$2,000,000,000 or more, by mid-1960, according to Dr. T. Keith Glennan, head of the National Aeronautics and Space Administration.

Jerome H. Stanek of the Stanek Tool Corporation of Milwaukee is one of eighteen new members added to the National Defense Executive Reserve of the BDSA, U. S. Department of Commerce. The reserve, now numbering 1332, is being organized to staff the operation of a production agency in the event of a national emergency.

The airframe industry, faced with declining military orders, may find an offsetting demand in the Navy's new hydrofoil subchasers, according to Rear Admiral R. K. James, chief of the Bureau of Ships. These boats, which skim on wing-like planes, are being developed for speeds of 50 knots or higher. Admiral James claims that the new concept represents a marriage of the airframe and shipbuilding industries.

Plant and equipment expenditures for the last two quarters of this year will be at the annual rate of about \$37,000,000,000, it is reported by the Department of Commerce and the Securities and Exchange Commission.

**HARDINGE**  
ELMIRA, N.Y.

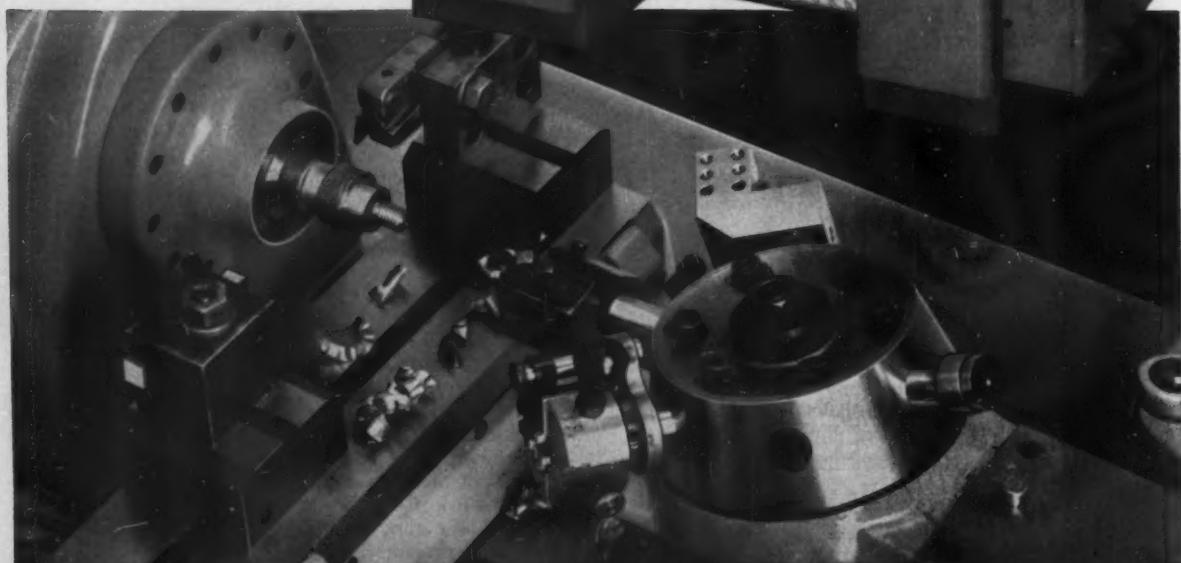
**Hardinge Machines Are Essential  
in the Production of  
Super Precision Second Operation Work**

**The New DSM59-R  
SECOND OPERATION  
MACHINE**



**1 $\frac{1}{16}$ " Collet Capacity  
6" Step Chuck Capacity  
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**Write For  
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## Time to Remember Our Freedoms

IN THESE DAYS of vitriolic vilification of the United States of America by the would-be dictators of world affairs, it behooves all of us to give some thought to the principles on which this nation was founded and to which it has adhered with remarkable consistency. Ours is a noble heritage of which we can always be justly proud.

Too many of us are prone to forget the freedoms guaranteed by our Constitution or the events of history that forged us into a nation sufficiently powerful to withstand the onslaughts of the communistic world. It is increasingly vital that Americans fully understand and tie fast to the values that made our nation great.

The Phillips Petroleum Co. believes external and internal dangers to be very real and consequently is offering its employes a concentrated six-hour course to reacquaint them with the history, achievements, and goals of our American economic system. Some eighty employes have been trained to conduct the course, which is made up of filmstrips and lectures. To date, over 20,000 employes have taken the course.

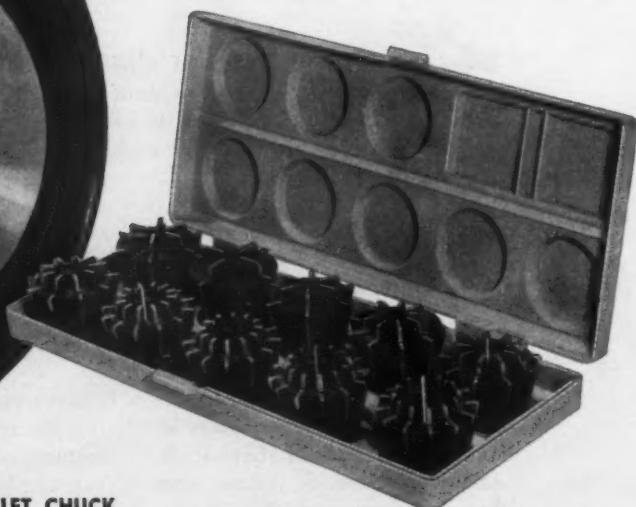
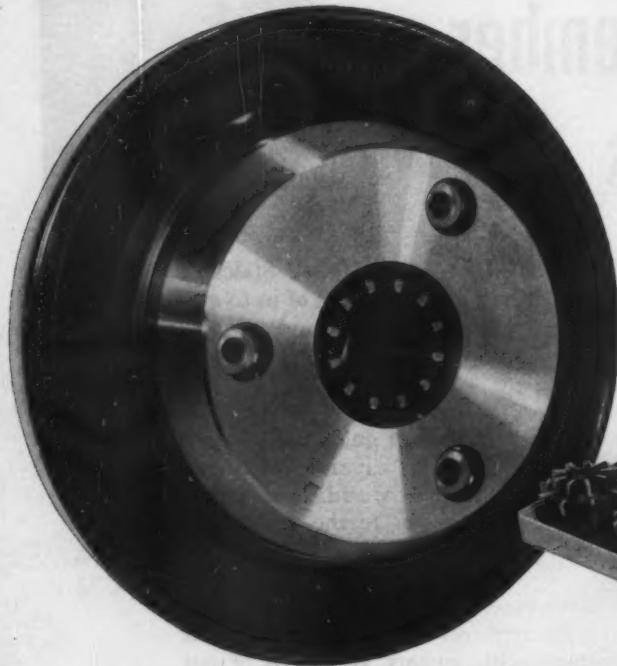
Soundly documented with facts and figures, the course tells . . . how Americans started out to make a living . . . how Americans won the highest standard of living . . . how American accomplishments compare with those of other countries . . . how Americans share the national income . . . why the American system has worked so well . . . what our American goals are—and how we can reach them . . . why people must be allowed free choice to work as they please for reward, instead of being forced to work for the "common good" . . . how workers' wages increase as machines help multiply manpower and raise productivity . . . why it is necessary that shareholders be paid for the use of their money . . . how individual freedom has made the American free-enterprise system work so well.

Our national well-being depends upon the understanding of our goals and our ability to analyze the issues before our government. The Phillips course helps to insure that we will continue to enjoy the benefits of individual freedoms and free enterprise, because their employes are in a position to intelligently discuss matters of national concern. More programs of this type are to be highly desired.

*Charles O. Herk*

EDITOR

# New MODEL 50 equips your lathes to do a lot more for a lot less!



THE WORLD'S MOST MODERN COLLET CHUCK

Designed expressly for ATLAS, CLAUSING, DELTA, LOGAN, SHELDON, and SOUTH BEND LATHES

These and others of similar power and capacity now give top performance when equipped with the new Jacobs Model 50. Improve performance of your lathes. Increase spindle capacity as much as 42%. Get greater accuracy and stronger grip. It's easy and inexpensive with new Model 50 and its companion Rubber-Flex collets.

## CONSIDER THESE FEATURES . . .

### • Gripping Power

Model 50 is made for heavy duty turning. It has tremendous gripping power.

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Model 50 is factory tested—maximum runout .001" T.I.R. at the nose when properly mounted.

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Always parallel Model 50 Rubber-Flex collet jaws permit chucking of tubing and fragile materials without crimping or scoring.

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The 10 Rubber-Flex collets in the 500 Series, developed especially for use with Model 50, cover a greater bar stock range than 63 old-fashioned steel collets. You can chuck any bar between 3/32" and 1-1/16" with this set of 10 collets.

### • Capacity

Model 50 eliminates capacity-wasting draw bar. You can increase spindle capacity up to 42%.

### • Adapters

Model 50 adapters are fully machined for immediate mounting. Available in all popular threads and American Standard L00 taper.

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Model 50 prices are revolutionary!

\$70.00 for the chuck.

\$65.00 for the complete set of 10 collets.

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AND RUBBER-FLEX COLLETS. YOU CAN'T AFFORD NOT TO!

See your Jacobs industrial supply distributor. Give him the opportunity to prove these fantastic facts with a convincing demonstration at your desk! Call him today.



**Jacobs**  
**CHUCKS**

The Jacobs Manufacturing Co., West Hartford 10, Conn.

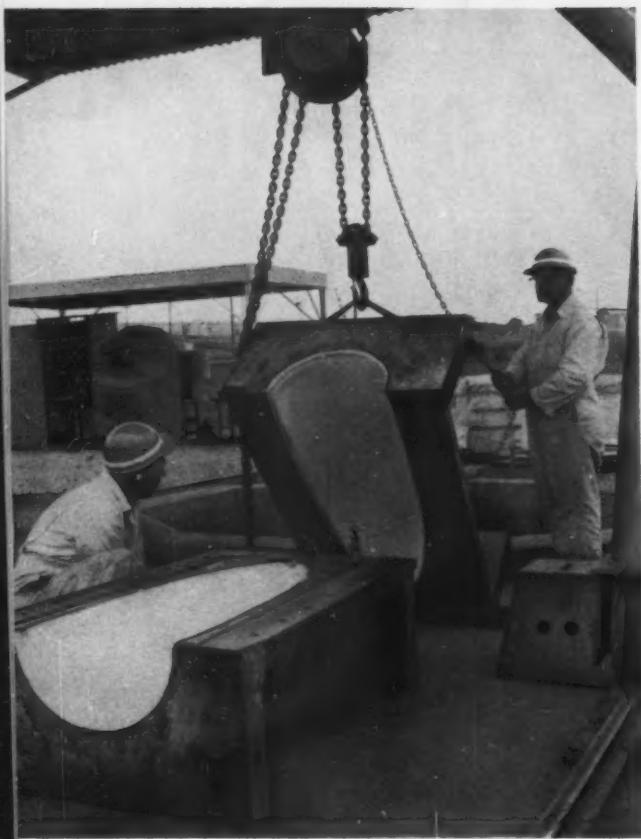
**MACHINERY**  
Vol. 67 No. 3  
November 1960

# EXPLOSIVE FORMING IN THE MISSILE INDUSTRY

**Dr. L. C. STUCKENBRUCK,**  
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Rocketdyne, a division of  
North American Aviation, Inc.



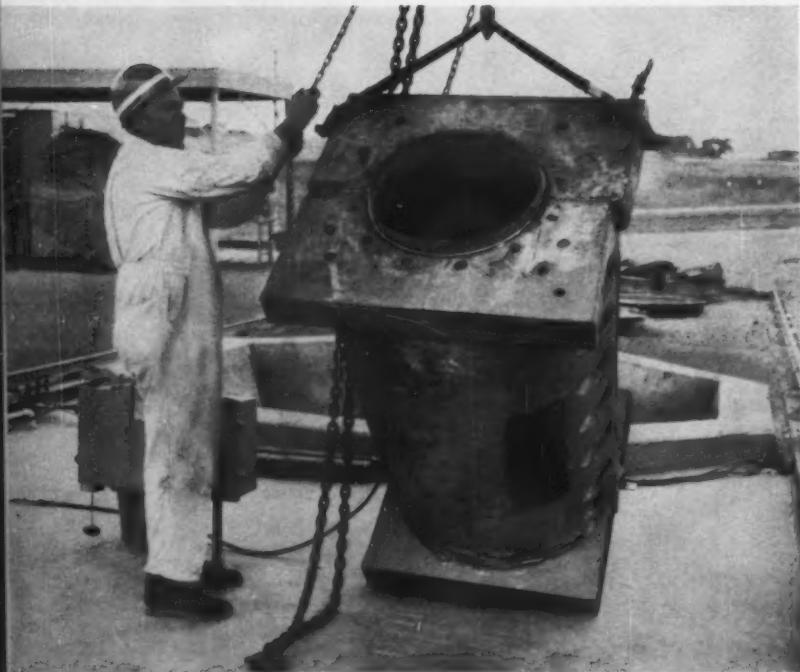
More information concerning a revolutionary fabricating technique  
whose true potential seems to be the forming of work that is beyond  
the present capabilities of conventional methods



**Fig. 1.** Two halves of an epoxy-lined die or mold that is used in sizing a large bullet-shaped aircraft skin section for explosive forming.

EXPLOSIVE FORMING HAS, for a number of years, been the most promising and, at the same time, the most controversial of the new fabrication techniques. It is only in the past year that this technique has lived up to its great promise and has been accepted as a standard fabrication technique. Explosive forming can now be viewed in its true perspective. It is obvious that it is not the answer to every difficult forming problem, nor can it replace all other forming methods. Almost any operation now performed with drop-hammer or other conventional techniques could be duplicated with explosive forming. However, there is generally no reason to do so, because conventional practices are cheaper and simpler. Explosive forming demonstrates its true potential in forming work beyond the capabilities of conventional methods.

Rocketdyne has demonstrated two general advantages of explosive forming, namely, low cost and full realization of metallurgical properties. Die costs can be considerably reduced since only a single male or female die is needed, rather than a pair of closely fitted dies. This advantage becomes more and more important with increasing



**Fig. 2.** With the two die halves securely bolted together to enclose the preformed component, assembly is ready to be lifted by a hoist and lowered into adjacent forming pit.

**Fig. 3. Removing the bullet-shaped aircraft component from the disassembled epoxy-lined die upon the completion of the explosive-forming operation.**

size and complexity of the formed part. Other forming methods have definite size limitations which are being exceeded by today's missile designers. Significant cost savings can be realized in limited production of close-tolerance parts. Close tolerances can be maintained with relatively inexpensive dies, particularly for short production runs.

Full advantage may be taken of the physical and metallurgical properties of the materials to be formed by the explosive method. By correct sizing and placement of the explosive charge or charges, and precise control of all operational variables, spring-back and work hardening can be minimized. Close dimensional tolerances can therefore be attained. Expensive and time-consuming annealing operations can in most cases be eliminated or at least reduced. It is easier to maintain uniform microcrystalline structure and hardness, even when subjecting a work-piece to successive explosive-forming operations. As a result, it is possible to come closer to realizing the full metallurgical properties of metals, such as elongation and ductility. This advantage has resulted in the successful forming of many complex



**Fig. 4. Dome-shaped tank end produced by welding together explosive-formed sections of SAE 1020 steel.**





Fig. 5. Manifold section about 4 1/2 feet in diameter, made from René 41 for use on a rocket engine.

shapes from exotic and difficult-to-form materials.

Explosive forming, for the most efficient application, should be used where it can be of real advantage. Instead of trying to do everything with explosive forming, the process should be considered as a new fabrication tool which can be used in conjunction with other techniques and to extend their range. Explosive forming extends present metal-forming technology to new horizons of size and materials. Size of the part to be formed has not as yet been a limiting factor, and the cost savings become more and more significant as size increases.

Explosive forming has proved to have its greatest utility in the forming of the exotic "space-age" metals. These materials, with high-temperature strength, low ultimate elongation, and high strength-to-weight ratios, are very difficult to form by other techniques. In many cases, explosive forming is the only workable technique. Rocketdyne has successfully formed such metals as aluminum, copper, nickel, tantalum, zirconium, columbium, and refractory high-strength alloys

such as 15-7 Mo and 17-7 stainless steels, René 41, and 6-4 titanium.

In fabricating one part at Rocketdyne in which explosive forming was used in conjunction with other techniques, individual sections were formed under the drop-hammer and then welded to form the rough part, which was then sized by explosive forming. The part was next heat-treated because it was required in the T-6 condition. It was given a final sizing by explosive forming to remove heat-treatment distortion and to attain the necessary accuracy of dimensions.

Rocketdyne's interest in explosive forming started in 1956 when better methods were sought for forming rocket thrust-chamber cooling tubes. Since that time, a number of feasibility programs have been conducted and the basic concepts studied. Acceptance of the technique was slow during the early development years. During the past year, however, an increasingly significant number of missile parts have been fabricated with substantial dollar savings, often amounting to 50 per cent.

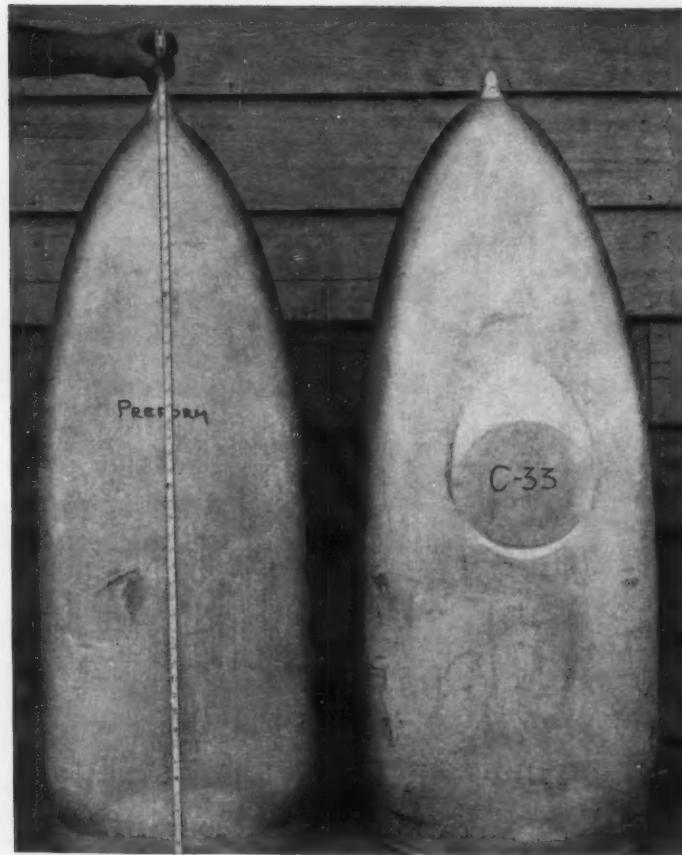


Fig. 6. Aluminum missile pylon cover approximately 4 feet high which was sized in the die illustrated in Figs. 1, 2, and 3.

Explosive forming is conducted at the Rocketdyne Propulsion Field Laboratory in the Santa Susana Mountains near Los Angeles. The area is sufficiently remote so that relatively large explosive charges can be used. A series of explosive pits of various diameters are dispersed around the area and barricaded so that they can all be operated simultaneously without interference. Structural frames and hoists are provided at each pit to facilitate the changing of dies and handling of work-pieces. Metallurgical and die-fabrication facilities are located close to the area, a general view of which is seen in the heading illustration.

Extensive research and development were conducted to determine the most satisfactory die materials and design. For long production runs, steel, Kirksite, and reinforced plastic dies have been successful. For forming a few parts of simple configuration, inexpensive concrete dies lined with plastic have been used.

The possibility of using epoxy-lined dies for certain operations is indicated by the die in Fig. 1, which consists of two die halves of Kirk-

site provided with fiberglass epoxy liners. The die is used to form an aircraft skin section in the heat-treat condition. It is designed to allow for easy installation of the preformed cylindrical shape with one closed end in the die cavity. In Fig. 2, the die is ready to be lowered into one of the water pits where the explosive detonation takes place to bulge the cylindrical shape into a torpedo-like shell. Two men are seen removing the finished part in Fig. 3. Lubricant applied on the part prior to forming enables the men to remove it easily from the die.

The majority of dies for complex shapes and heavy materials are made of steel. Rocketdyne's experience has been that die design is one of the more important factors in the successful forming of a part explosively.

Explosive forming has been applied in the fabrication of all the major parts of a missile. Representative parts made at Rocketdyne will be described. For example, liquid-propellant missile tanks and solid-propellant motor cases have been formed either completely or in part by explosive

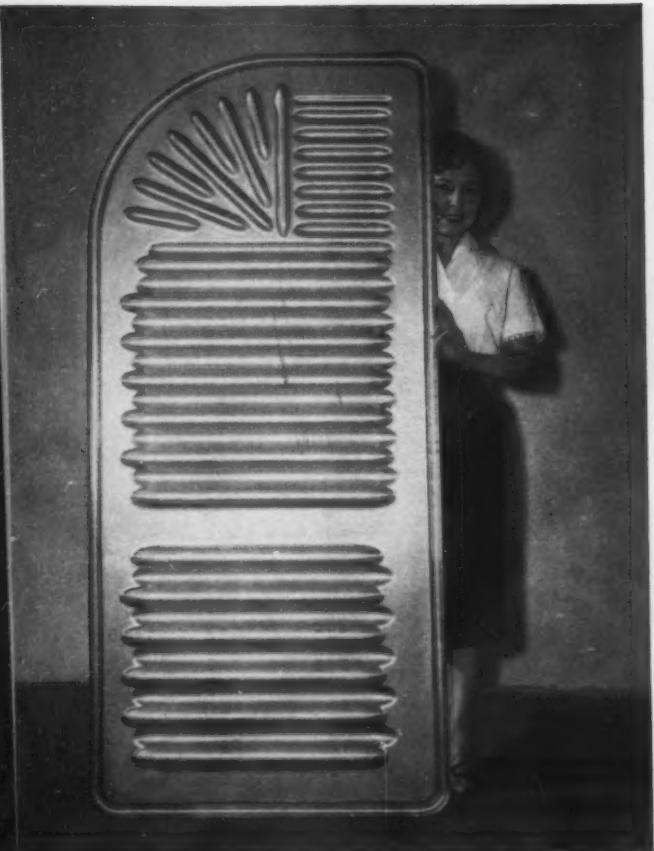


Fig. 7. Structural panels and bulkheads with beaded web stiffening configurations are satisfactorily fabricated by explosive forming.

Fig. 10. (Right) Complex shapes such as cooling jackets have been explosively formed from nickel, stainless steel, Inconel X, aluminum, and zirconium.

Fig. 11. (Below) Rocket-engine thrust chambers have been explosively formed within tolerances as close as 0.002 inch on the diameter of small parts and 0.010 inch on larger components.

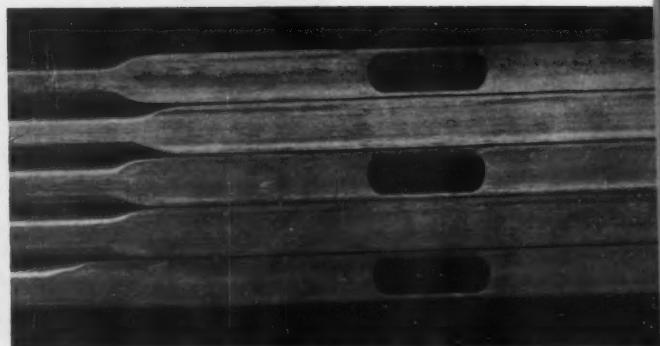
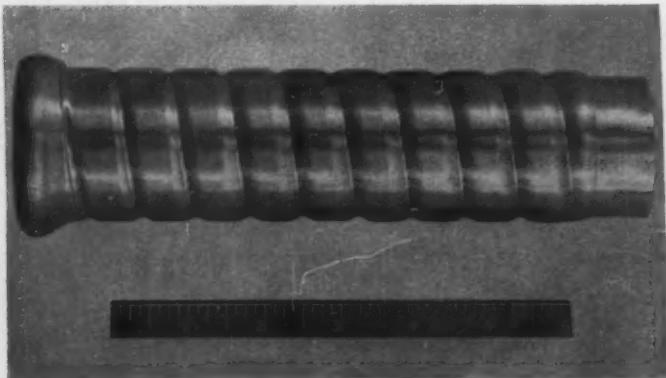


Fig. 8. Five tubes of a type that must be squared on the ends for applications in rocket industry.

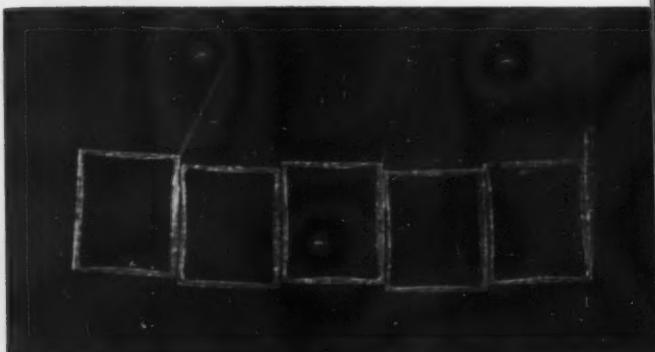
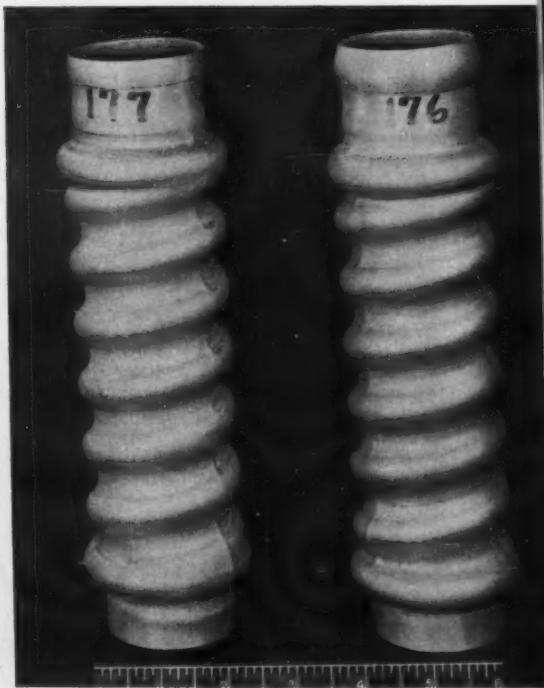


Fig. 9. Five round tubes with ends that were accurately squared by applying the principle of explosive forming.



forming. A tank end explosively formed from SAE 1020 steel is shown in Fig. 4. Similar tanks have been formed from stainless steel, aluminum, and titanium in thicknesses from 0.030 to 0.125 inch. This particular part is 5 feet in diameter by 3 feet deep. Parts of this type are ideally suited for explosive forming and size is no problem.

Rocket engines utilize a number of structures such as manifolds for conducting hot gases, which must be fabricated from high-strength, high-temperature alloys. The most widely used of these new refractory materials at Rocketdyne has been René 41. A manifold section approximately 4 1/2 feet in diameter (after trimming) is shown in Fig. 5. This part was drawn several inches without requiring annealing, whereas conventional forming techniques would require at least two anneals.

Due to their large size, missile enclosures and skin sections have permitted ideal applications of explosive forming. Nose cones, radar housings, pylons, and fuselage sections have been formed or sized. Most parts of this type are relatively simple and by using explosive forming, large sections can be formed to close tolerances.

In some cases, large sections of an entire fuselage assembly, including punched-out doors and access panels, have been formed from a single sheet of metal. Typical parts have been formed from 2024, 6061, and 7075 aluminum, and from 321, 15-7, and 17-7 stainless steels. The example shown in Fig. 6 is a 7075 aluminum missile pylon cover, approximately 4 feet high. The part was made in two halves which were drop-hammer formed. The halves were then welded together and the part was sized by explosive forming, which was the only means found that would produce the part within required tolerances. This is the part made in the die, Figs. 1, 2, and 3.

Missile structural panels and bulkheads with beaded web stiffening configurations can be very satisfactorily fabricated by explosive forming. The panel shown in Fig. 7 is 3 by 6 feet and was formed from PH 15-7 Mo in one operation. Very little thinning and no warpage or wrinkling occurred. A single female Kirksite die was used.

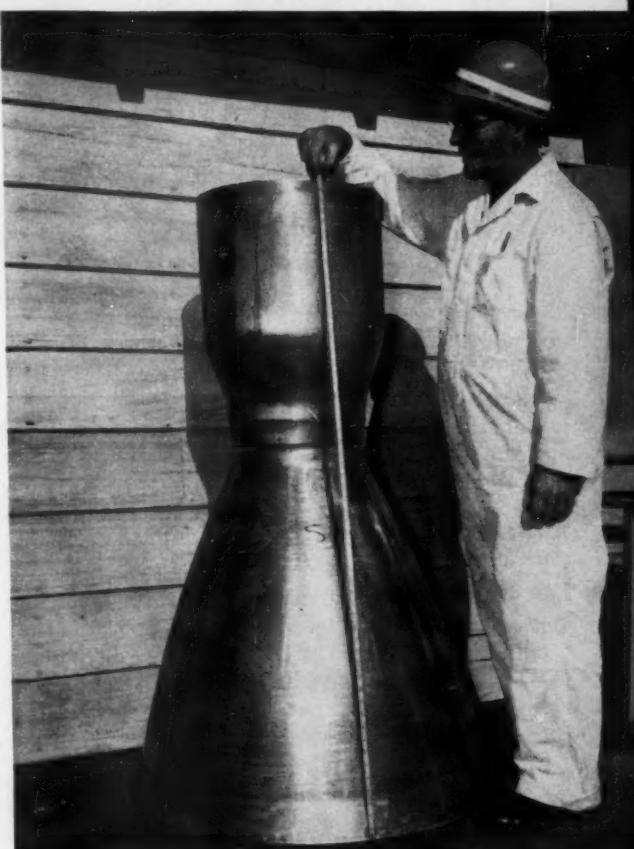
The rocket industry requires extensive use of tubing and cooling ducts fabricated from all types of materials. Such components are "naturals" for explosive forming. Tubes for regeneratively cooled liquid-propellant rocket chambers provided an unusual application. The ends of the tubes had to be square so that they could be successfully brazed. Special explosive charges and fast operating dies were developed for squaring the tubing and sizing to insure a proper fit on the brazing mandrel. The appearance of the squared tubing is shown in Figs. 8 and 9. Corner radii of only 0.0008 inch were consistently obtained.

Complex shapes such as the cooling jacket shown in Fig. 10 have been produced by explosive forming. Materials used have been nickel, 321 stainless steel, Inconel X, 20 CB aluminum, and zirconium.

The forming of rocket-engine thrust chambers has been quite thoroughly investigated. Small chambers such as that shown in Fig. 11 have been made in considerable quantities. One of the advantages of the explosive-formed part is the consistency with which required tolerances can be held 0.002 inch on the diameter of a small part and 0.010 inch on a larger part. Very sharp radii can be obtained in the spiral cooling-passage grooves.

No large thrust chambers have been formed but similar structures have been fabricated as shown in Fig. 12. This part is a mandrel explosively formed to close tolerances and used for assembling the tubes in a cooled rocket-engine thrust chamber. The part was made in two sections so that it could be removed after assembly of the tubes.

Fig. 12. Mandrel made up of two explosively formed sections for use in assembling the tubes of rocket-engine thrust chambers.





**Telecontrol—electromechanical equipment  
for "total production control"—was installed recently  
at the Hoover bearing plant to determine the specific  
reasons for . . . and minimize . . . short-time interruptions in output**

INTERMITTENT and UNPREDICTABLE short-time interruptions in the production obtained from various machine tools were adding up to a considerable amount at the bearing plant of the Hoover Ball & Bearing Co. Specific reasons for such short down times—often amounting to only a few minutes on individual machines—could not always be pinpointed by the foremen.

To track down unknown reasons for inefficient utilization of capital equipment—so that they could be analyzed and corrective measures taken—Telecontrol was installed. The equipment, made by the Telecontrol Division of Hancock Industries, Inc., Jackson, Mich., provides, among other functions, a simple electromechanical method of registering production data for each individual machine in a centralized control room. The equip-

ment also provides a plant-wide signaling and communications system.

With Telecontrol, work stations and machine tools are equipped with sensing devices to electrically count the number of work-pieces produced. The sensing device used on a Conomatic four-spindle automatic bar machine of 3 1/2-inch capacity is illustrated in Fig. 1. As each machined bearing race is indexed into the cutoff station, it contacts and pivots a spring-loaded rod that projects from the underside of an Allen-Bradley limit switch. On some of the smaller-size automatics, it is necessary that the counting lever pivot into the tooling area during each indexing cycle, because of a limited space.

Each sensor is connected to a control box, such as the one shown mounted on the right-hand end

# TRACKING DOWN THE UNKNOWN IN PRODUCTION CONTROL

ROBERT B. PARKER, Production Control Manager  
Bearing Division, Hoover Ball & Bearing Co., Ann Arbor, Mich.

of the Acme-Gridley six-spindle automatic screw machine in Fig. 2. This machine is set up to produce inner races for water-pump bearings. The control boxes are equipped with red and green signal lights, an operator's toggle-action "help" switch, a key-operated down-time switch, and a jack for plugging in a portable telephone handset as seen in the heading illustration. "Press-to-talk" telephones, carried by the foremen of the various departments, permit two-way conversations with the dispatcher in the control center seen in Fig. 3.

Wiring to transmit signals from the various machine control boxes, as well as the sensing device counts, is connected to individual, corresponding control panels in the central control room. The individual control panels are mounted twenty to a vertical cabinet. Four cabinets in the Hoover installation take care of eighty production machines or stations. Additional cabinets could easily be installed to expand the installation whenever required.

Each individual control panel has two sets of three counters, as seen in Fig. 4. One set of counters is used for the current working shift, and the other set for the following shift. The left-hand counter in each set indicates the productive time elapsed in 0.01-hour (36-second) increments; the center counter shows the down time (nonproduc-

tive) elapsed in the same time increments; and the right-hand counter records the number of work-pieces produced. A "balance" counter, which is preset at the start of each shift, is also provided at the right on each panel to indicate the number of parts still to be produced to complete the particular order.

Each individual control panel is also equipped

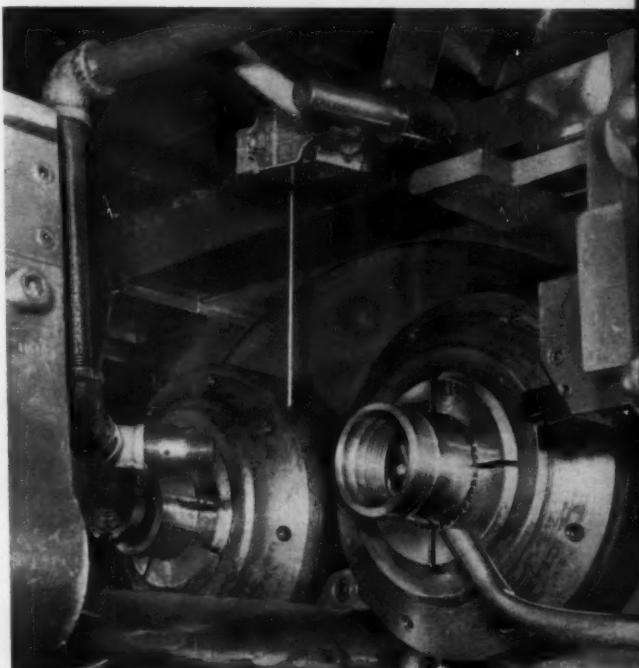


Fig. 1. As each bearing race indexes into the cutoff position of an automatic, it operates a limit switch to actuate recording equipment in a control room.



Fig. 2. When an operator needs material, an inspector, or a setup man, he flips a switch on machine control box to Alarm position.

with a red and green signal light (corresponding with those on the individual machine control boxes), two activating jacks for inserting an operator's or setup man's plug for the appropriate shift, and slots for holding the machine identification number and an IBM job-order card. Standard printed cards are also provided for insertion in the slots to indicate that the machines are "Unscheduled," "Being Set Up," or "Ready to Run." To activate a particular control panel, a plug having an operator's or setup man's number is inserted in one of the two jacks. This completes

the circuit to the corresponding machine control box and its sensing device.

A master programmer, which is an integral part of a Telecontrol monitor cabinet (seen at the left in Fig. 3), energizes the entire system at the beginning of each shift—in synchronization with the plant's master time clock. Among other things, it turns on the green lights on the control panels, as well as the corresponding green light on each control box of the various machines scheduled for operation during that shift. The operators know that when the green lights are on, their machines are ready for production, and that the corresponding panels in the control room are registering productive time and will automatically record each unit produced by the machines.

When the required number of work-pieces has been produced on a particular machine, the green lights on both the machine's control box and its corresponding panel in the control room automatically begin to blink. The blinking green light warns the machine operator to stop producing parts, and signals the dispatcher in the control room to page the foreman of the particular department in which the affected machine is installed. An audio "beeping" accompanies the flashing of any green light in the control room. Thus, overruns or underruns of production are automatically controlled and eliminated.

Before each order is completed, the control-room dispatcher selects the next job to be run on the particular machine involved and inserts the job-order card in the slot of the machine's

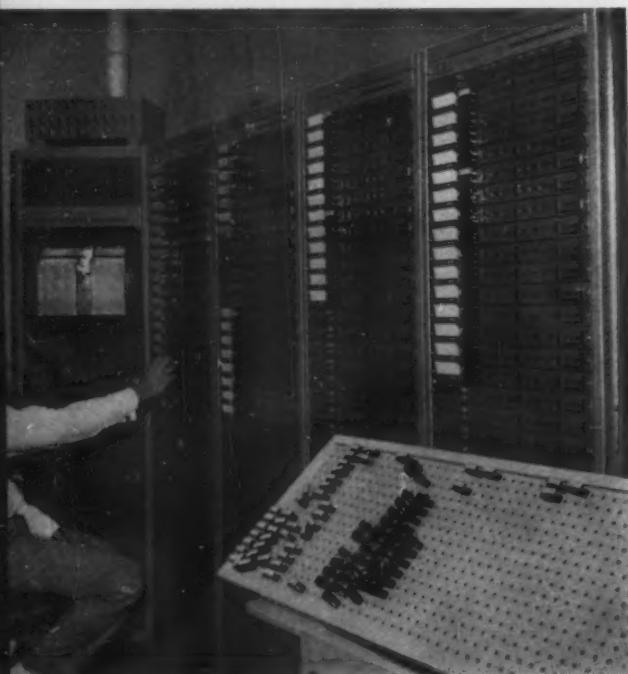


Fig. 3. Central control room which has individual panels connected by wiring to control boxes and sensing devices on various machine tools throughout the plant.

**Fig. 4.** Each control panel has two sets of three counters to indicate the productive time, down time, and number of parts produced on two successive working shifts, and number of parts still to be produced.



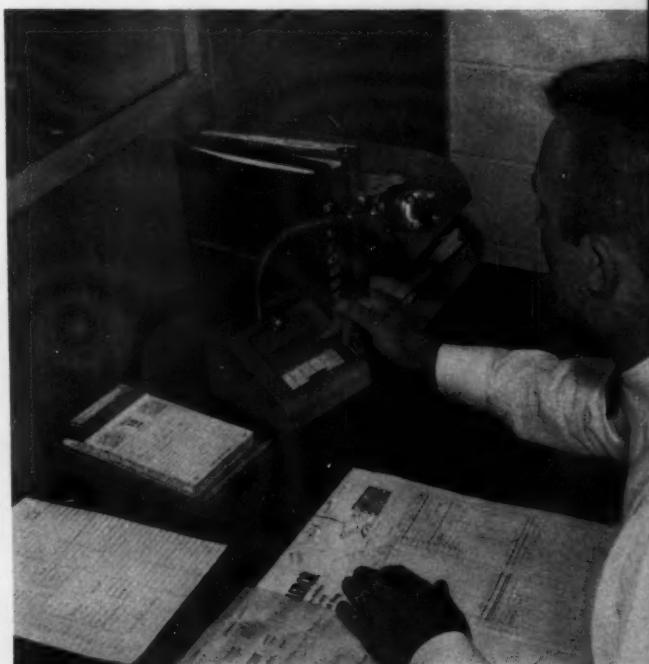
control panel. This automatically furnishes the plant with a master schedule board that shows the machine load and the order in which the backlog of each machine is to be scheduled.

Whenever a machine operator needs assistance, such as a supply of raw material or the removal of machined parts, he flips the switch on his machine control box to "alarm," as indicated in Fig. 2. This causes the red light on the box to blink, as well as the one on the corresponding panel in the control room. The audio beeping further prompts the control-room dispatcher to page the foreman of the proper department by means of a voice paging system (see Fig. 5). Upon arrival at the affected machine, the foreman plugs his portable telephone handset into the intercom jack on the control box, as seen in the heading illustration, and advises the dispatcher of the specific type of service needed. The dispatcher then uses the voice paging system to summon the necessary material or the materials handler. In the meantime, the operator continues to run the machine, producing work-pieces without having incurred any lost time or production stoppage.

Should the machine operator need assistance at any time because of tool or machine failure, he summons and receives immediate help from the dispatcher and foreman in the same manner. Under such conditions, there will necessarily be some down time, but it is of relatively short duration because of the high-speed signalling and communication features of Telecontrol. For ex-

ample, the machine operator does not have to go looking for the foreman to report the breakdown, nor does he have to clock his down time "in" and "out."

Upon arrival at the affected machine, the foreman immediately transfers the machine operator from productive time to down time by inserting and turning a key in the down-time switch on the machine control box. This causes the red signal lights on both the machine control box and the panel in the central control room to glow without flickering. At the same instant, the recording



**Fig. 5.** Voice-paging system in central control room enables dispatcher to send foremen, material handlers, inspectors, and maintenance men to service machines.

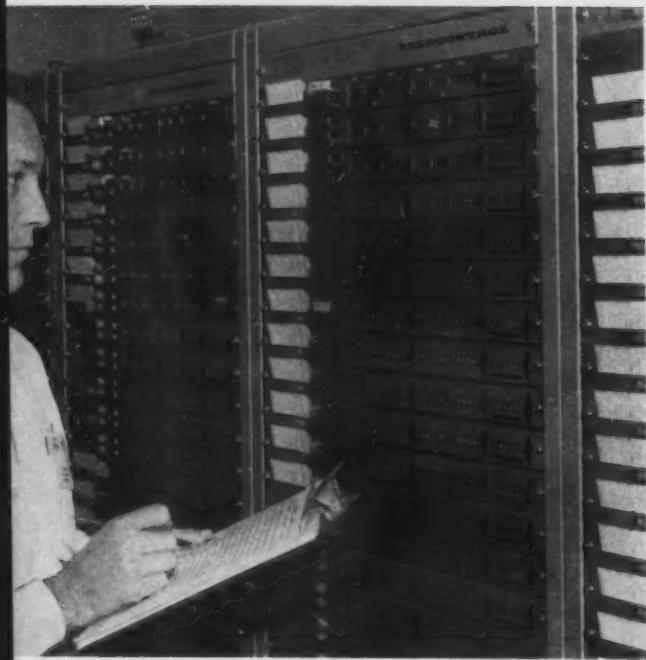


Fig. 6. Dispatcher in control room records data from control panels at the end of each shift, or when a job order has been completed.

time switch to its original position on the machine control box. This action switches the time recording back to the productive counter, turns off the red signal lights, and reactivates the parts counter.

At the end of each shift and upon the completion of each job order, the control-room dispatcher takes pertinent information from the control panels and posts it on printed forms, and on IBM cards, which are subsequently punched. The information includes productive time, down time, parts produced, and balance to be produced. The dispatcher also turns the counters to zero and resets the balance counter in the case of an order completion. The on-and-off time cycles and the number of parts produced on each machine are also automatically charted on the graphic or "events" recorder shown in Fig. 7. This recorder has forty pens and is an integral part of the Telecontrol monitor cabinet in the central control room. The number of parts produced is plotted on a running time chart. Each time that a machine's sensing device "closes," when a part is produced, the corresponding pen draws a horizontal line on the chart paper. The charts move vertically past the marking pens at variable rates. They are kept as permanent records, and are valuable in determining the performance of individual machines with respect to setup time and down time and for setting or checking work standards.

With the centralization and automation of the producing, gathering, and recording of timely, accurate production data provided by Telecontrol, an immediate analysis could be made of the reasons for "nonvisible" down time. The study was first concentrated on automatic screw machines and multiple-spindle bar automatics, because of their intermittent operation and the unpredictable short-time interruptions in their output. While it was realized that setup on such machines required a relatively fixed per cent of their available productive time, it was revealing to find from the Telecontrol data that approximately an equal amount of the available time was being spent waiting for the machines to be set up. Immediate steps were taken to minimize this waiting time.

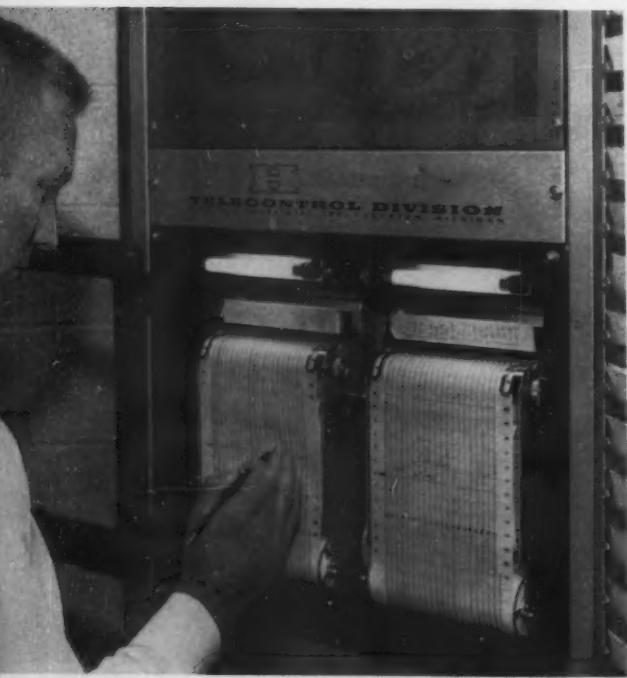


Fig. 7. Data on productive time, down time, and the number of parts produced on each machine is automatically charted on this forty-pen recorder.



Fig. 8. Telecontrol equipment is installed on this Cincinnati Micro-Centric machine, which is set up to grind ball grooves around inner ball-bearing races.

Another application of Telecontrol equipment has been on the Cincinnati Micro-Centric grinding machine in Fig. 8, which is used to grind the ball grooves on inner races of ball bearings. Here, a foreman is seen talking to the control-room dispatcher about the next job order to be processed on the machine. Another machine equipped with Telecontrol equipment is a Heald Centric-Matic bore grinder.

One of the major benefits of the Telecontrol installation has been improved scheduling. Scheduling was often a problem, particularly in the automatic screw machine department. Here, about 150 different parts (out of a total of 450) must be scheduled each month for production on 30 machines. Since each operator usually attends a bank of four machines, it is a considerable advantage not to have two or more machines in any bank complete a job order and need a new setup during the same shift.

Prior to the installation of Telecontrol, it was difficult to prevent this situation due to the delay in manually obtaining control data. Now, with the accurate production data instantly available from Telecontrol, it is possible to mix large and small job orders among different banks of machines and authorize overruns or even decrease the order size. In this way work completions can

be readily controlled. This improved machine loading and maximum utilization of expensive capital equipment has also made possible better inventory control. Improved scheduling permits lower inventories, which means more profitable operation.

Another major benefit obtained with Telecontrol is that paper work has been taken out of the shop. Clerical work is now done by clerks, and operators can concentrate on attending their machines. Previously, the operators had to keep records, including a machine log that gave operating time, down time, and the reasons for down time. Also, a production ticket had to be filled out for each job order. Such paper work required considerable time.

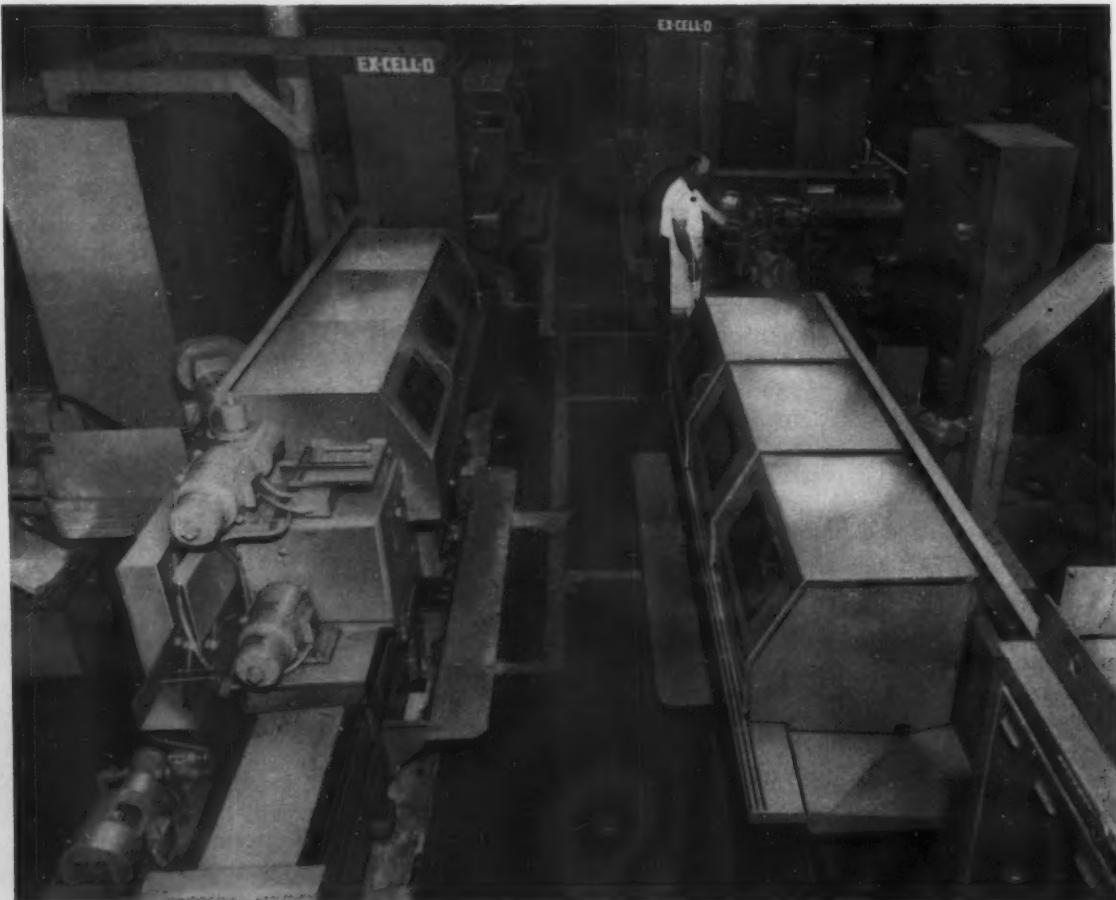
The delay between factory paper work, accounting tabulation, and management analysis was slow and costly. Now, management can, at a glance, scan and analyze the productive effort of the entire plant by visiting the control center or scanning the timely, accurate data obtained by Telecontrol. Immediate information is available on which machines are operating, which orders are nearing completion, the orders that can be scheduled next on each machine, and so on. Paper work required in payroll, accounting, and billing functions is minimized.

# **STEAM TURBINE-BUCKET INCREASES NUMERICAL PROFILING EFFICIENCY**

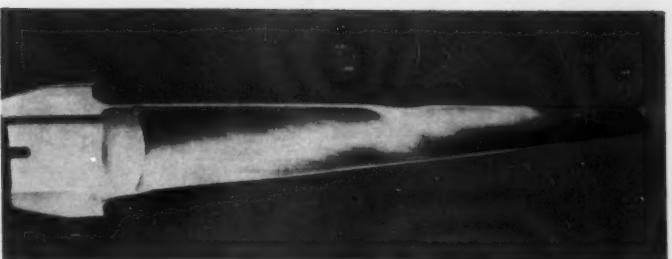
**Tape-controlled profiling machines free bucket-vane  
designers from tooling cost constraints.**

**The result: more efficient steam turbines at reduced cost**

**LAURENCE W. COLLINS, Jr.**  
**Associate Editor**



**Fig. 1. Battery of four bucket millers, each with separate tape control. Sliding covers with windows keep down cutting coolant spray. The operator of this battery has enough free time to sharpen the cutters for the millers.**



**Fig. 2.** New 26-inch turbine bucket, milled by tape control, is more efficient, costs less to process and finish.

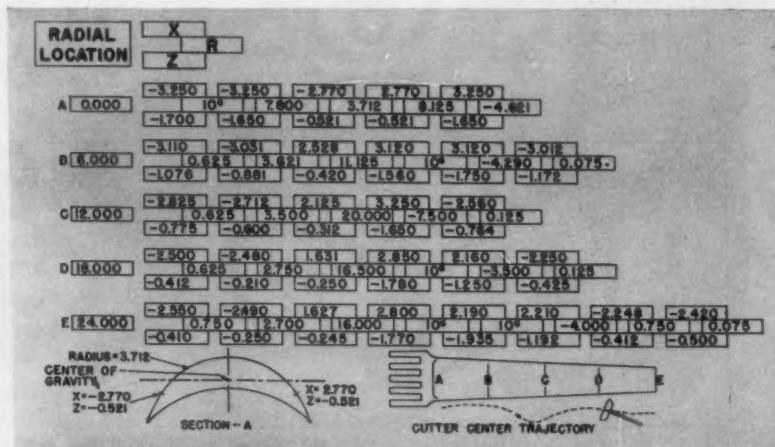
A TYPICAL STEAM-ELECTRIC generating power plant costs about \$150 per kilowatt of capacity installed. About half of this cost is chargeable to the steam system "before the turbine throttle," and about half to the mechanical and electrical system after the throttle. A kilowatt saved in the design of a turbine means a "cost kilowatt" of steam that does not have to be supplied to deliver the rated amount of power. In other words, about half a kilowatt cost of \$150 is saved, or \$75.

But the new lower-cost turbines show other savings for alert utility managements. A modern, extremely efficient steam-electric plant consumes about 0.7 pound of coal per kilowatt hour of power produced, and a new plant runs about 8000 hours per year. This means that one kilowatt of loss saved cuts coal consumption by 5600 pounds per year. At \$10 per ton, this is \$28 saved per kilowatt per year. In the case of one new 200,000-kw turbine running at full load for 8000 hours, this represents a yearly saving of about \$56,000 in operating expense.

Most significant in improving the efficiency of the newest low-pressure steam turbines is the availability of improved turbine buckets. The turbines now being built by the Large Steam

Turbine-Generator Department of General Electric Co., Schenectady, N. Y., deliver their rated kilowatts at a cost of fewer tons of coal. Better turbine buckets are the result of making them longer and contouring them more accurately through the use of tape-controlled milling on Numera-Trol machines built by Ex-Cell-O Corporation, Detroit, Mich. A battery of four of these machines, Fig. 1, all controlled by individual analog programs on magnetic tape, are now in daily operation. Numerically controlled milling is adapted to the relatively short runs of rotating bucket vanes, Fig. 2, in any given order.

The machine control system is a combination of numerical contouring control and digital computer techniques provided by the Specialty Control Department of General Electric Co., Waynesboro, Va. The bucket-vane designer, using these digital controls and a computer for programming the tape, no longer is restrained by tooling and setup cost considerations, as in the past. He can now design for the greatest efficiency, and the bucket miller faithfully produces the design. Last-stage buckets from 26 to 50 inches long are now being milled automatically. In operation, the tip speed of these buckets is on the order of one and one-half times the speed of sound. Indica-



**Fig. 3.** Turbine-bucket chart lists mathematical solutions for as many airfoil cross sections on the length of the bucket as is necessary to program the machine for milling. The sketches below the table illustrate the references, with symbol (R) designating vane twist.

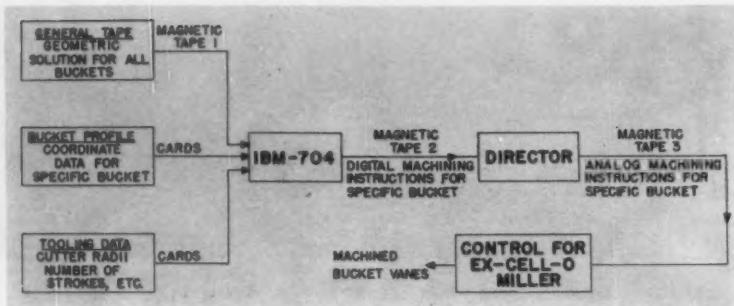


Fig. 4. Assembly, development, and processing of data for milling bucket vanes flows in accordance with this schematic diagram, which shows the uses of the two different digital magnetic tapes that must be made before the final analog control tape is able to be programmed.

tions are that present bucket lengths may increase; therefore the millers are capable of handling possible future increments in lengths up to 72 inches.

When a turbine-bucket designer engineers a new vane shape for tape-controlled milling, the last step in his procedure is the writing of a part description, planned specifically for tape-programming input. This is a table of co-ordinate values, Fig. 3, describing the contours for a series of desired airfoil cross sections. These cross sections are arranged along the length of the vane as closely as needed to prescribe the changes in bucket contour. In Fig. 3, which represents a bucket needing only five cross sections, each horizontal run of numbers defines completely one cross section; while its relationship to the rest of the bucket is indicated in the diagrams below the table. The system of co-ordinates originates at the center of gravity for each cross section, but a shift to any desired machining center line may be specified in the machining data input. A radius of  $10^6$  inches is interpreted by General Electric's IBM-704 computer as a straight line. The dotted line trajectory in the sketch, Fig. 3, (lower right corner), shows one of the ultimate paths of the milling cutter's center with cuts generally parallel with the bucket axis. The machining of one bucket may require as many as 250 related trajectories of this kind.

The programming for milling a bucket vane

begins by feeding into an IBM-711 card reader the complete basic numerical solutions of the blade profiles from a table such as Fig. 3. The output is a 1/2-inch tape shown on the flow diagram, Fig. 4, as Magnetic Tape 1. This tape—supplemented by two sets of punched card information, Fig. 4, containing the index angles for each of the milling cutter passes, the start and ending locations, and the geometry of the cutter—is fed into the IBM-704 computer, Fig. 4. The schematic flow diagram traces the data-processing steps of the several sets of instructions, showing input geometric and tool descriptions processed within the computer into a data table of cutter-center locations. This data table, while still within the computer, is then interpolated to produce discrete information for the cutter-center motion in each milling pass. The cutting path is developed by adjusting the motion for the cutter center in three planes, Fig. 5. Thus tangency between the cutter and the bucket envelope is achieved, Fig. 6, the term "envelope" referring to the path followed by the cutter's center during machining of a complete bucket surface, all calculations completed instantaneously within the computer.

The surface areas between the defined cross sections are blended within the computer, using a second-degree curve. The output at this stage is now recorded on 1/2-inch tape (Magnetic Tape 2) containing digital instructions for speed and acceleration calculated for each motion in-

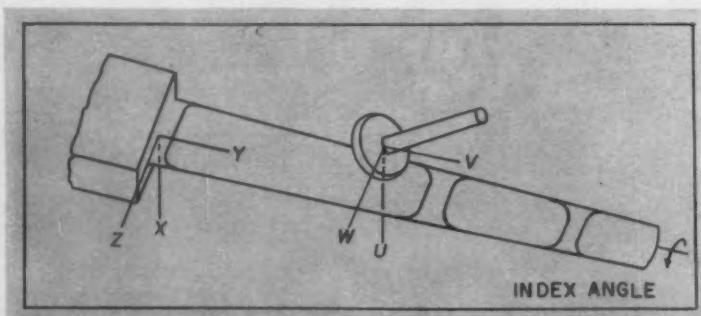
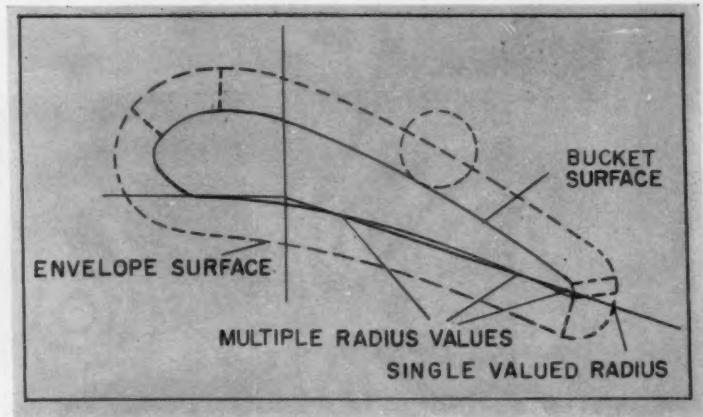


Fig. 5. Isometric view of the cutter and its co-ordinates (U, V, W) in relation to the bucket surface co-ordinates X, Y, Z.

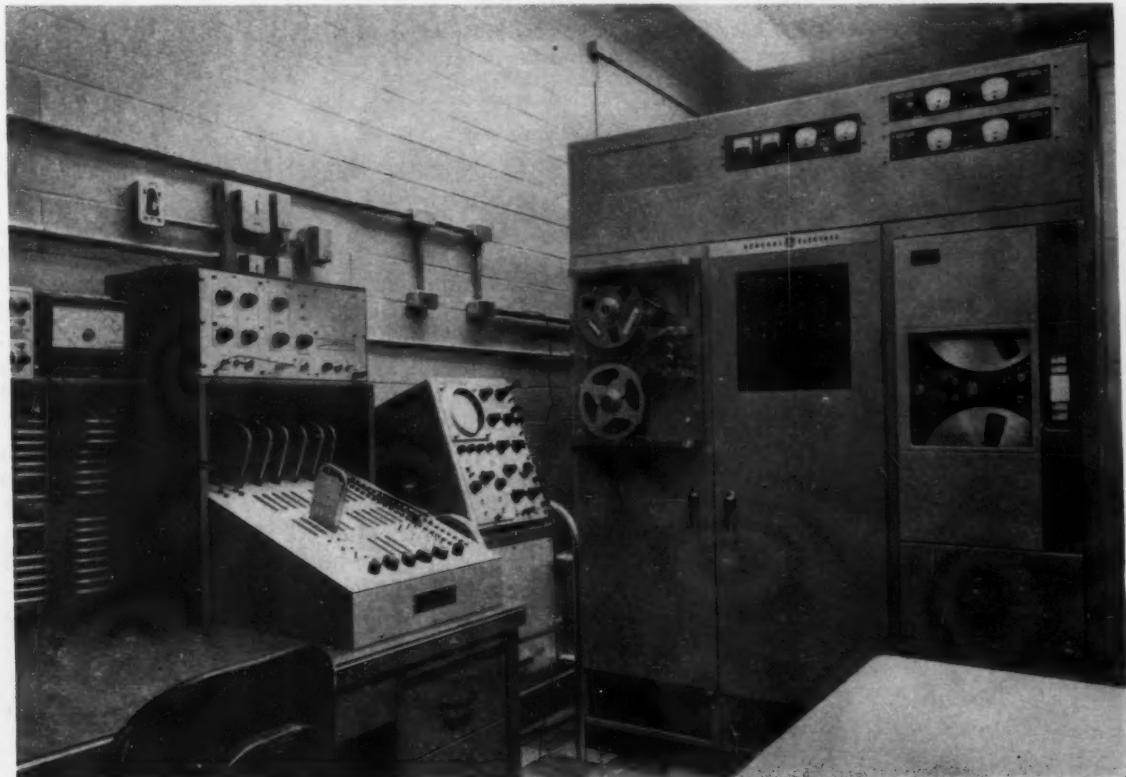
**Fig. 6.** The generation of the envelope surface (broken line) at a typical cross section on a turbine bucket. The envelope surface represents the cutter center for data interpolation.



rement along each cutter pass. Taped information includes commands such as cutter "on and off" and cutting oil "on and off." An IBM-704 machine will run off such a tape in twenty-five to forty-five minutes, depending on the number of cutter passes and the number of cross sections in the data.

Finally, Magnetic Tape 2 is inserted in a special data-processing machine called a "director," Fig. 7, developed for turbine-bucket work by the

Specialty Control Department of General Electric Co. By interpolating between discrete points, the director produces a parabolic interpolation of the digital program on 1-inch-wide magnetic analog tape. This tape includes complete analog instructions for machining a specific bucket and incorporates both continuous and intermittent function instructions (Magnetic Tape 3.) Positioning information is given by phase difference between the controlled motion and the reference



**Fig. 7.** Digital tape information is converted into analog machine control data by the director on the right, which interpolates data for the best machine programming. On the stand in the center is the read-out oscilloscope for checking control-tape error.

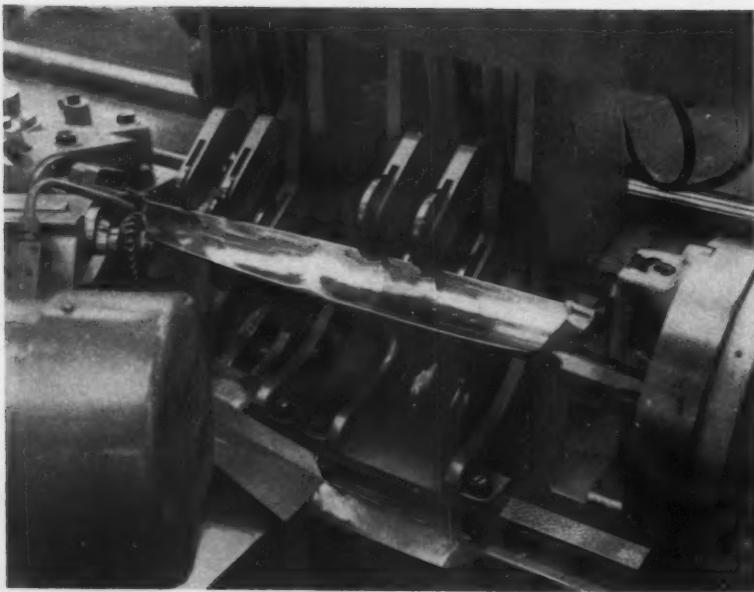


Fig. 8. Combination of radial indexing and table-traverse data, with analog cutter motion control, produces three-dimensional effect in the milling of a turbine-bucket vane. The milling cutter, left, is at 30 degrees to the work axis. Along the bucket, looking like cam followers, are the backups which support the blade against the thrust of the cutter.

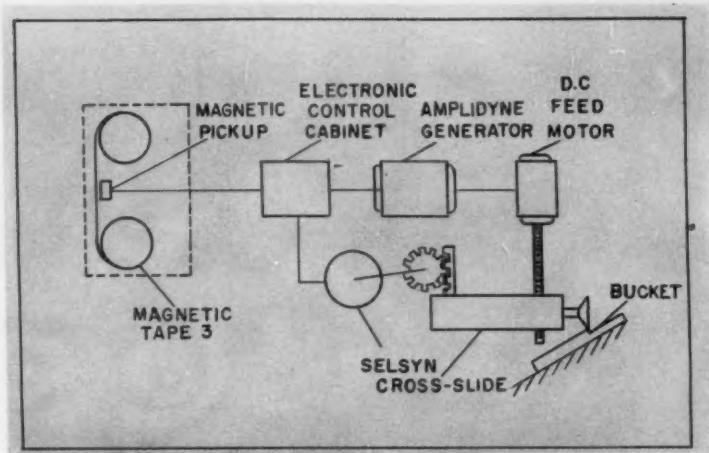


signal, all of which are 200-cycles-per-second square waves, Fig. 10.

The director operates in "real time" and therefore makes as long a tape as the time required for completely machining a given bucket. The tape for a bucket requiring over an hour to mill may fill more than one spool. Counting zero-motion time as well as various stops, about sixty minutes of machining time can be programmed on each standard-length spool of analog tape.

Magnetic Tape 2 may be processed through the director an indefinite number of times to make Magnetic Tape 3 analog duplicates that will permit a battery of blade millers to work on the same turbine bucket, or to replace damaged control tapes. The Magnetic Tape 3 analog control tapes may be used a number of times, usually lasting about 400 buckets, before they wear out. The analog control tape can be "read back" for checking purposes by means of an oscilloscope,

Fig. 9. Vanes begin as forgings for tape-controlled profiling. The 26-inch bucket on the left used to be considered big. New, more efficient turbines have 50-inch buckets (right). Note two faired bosses on each.



**Fig. 10.** For any particular motion, the magnetic pickup head "reads" the position-intelligence contained in the tape. This data is supplied to the electronic controls of the machine tool. Data is in the form of magnetic pulses of a given phase relationship to a reference channel, also consisting of magnetic pulses. A 36-degree phase shift of the 200-cps square wave is equivalent to 0.001 inch of linear travel.

Fig. 7, where motion errors are easily spotted by an experienced technician.

The machine tool portion of the Numera-Trol system used in milling turbine buckets is basically an Ex-Cell-O Corporation thread grinder such as might be used for finishing threads in machine tool lead-screws, Fig. 1. The carriage headstock holds the turbine bucket by the root (Fig. 8) in a special pair of jaws while the tailstock centers the blade tip, using a nub or machining boss that later will be trimmed off. The carriage headstock therefore does not drive the work. Instead it indexes the work between machining passes.

In place of the usual grinding spindle the machine's transverse slide mounts a 5-hp milling head at 30 degrees to the work axis. The tungsten-carbide cutters are toroidal in shape with brazed carbide bits. Experiments with clamped-on carbide bits are under way. Best results are obtained at about 0.004-inch chip load with the cutter turning at 600 sfpm. Depth of cut is about 0.125 inch. The steel blanks, Fig. 9, are hot-forged from a 13-per cent chromium, 0.30-per cent carbon alloy, machined at 225 to 250 Bhn. This steel is classed as a magnetic stainless and possesses the excellent vibration-damping factor desirable for turbines.

Longitudinal carriage feed in both directions is held relatively constant to deliver the optimum chip load with cutting passes made in both directions. The transverse slide (carrying the milling head) moves on instructions from the analog tape. Initially, the cutter is set at a predetermined position relative to the center line of the bucket. The work-table is preset relative to the center line of the machine. Once the operator presses the start button, the control system takes over

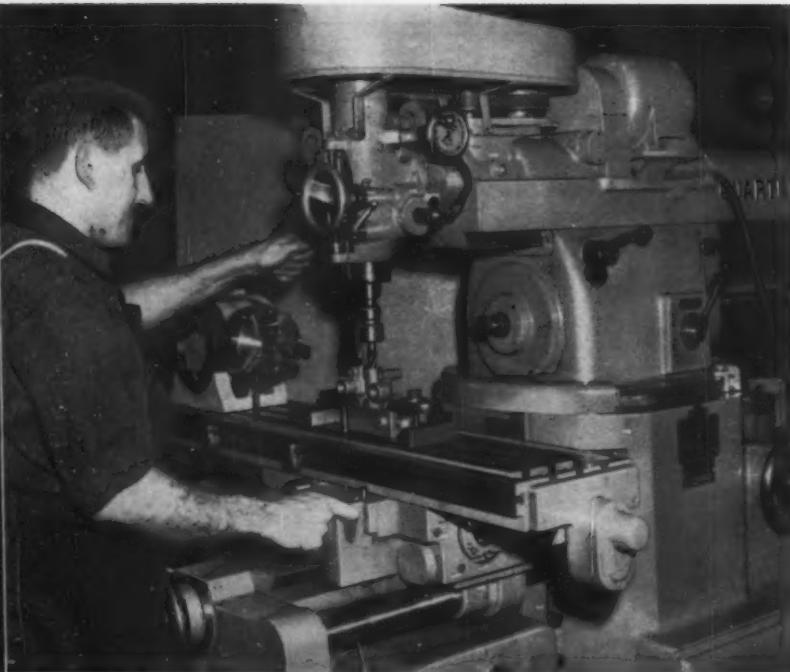
and will run through the whole tape. A given order is run off without operator attention, except to take out finished work and put in new blanks. A typical milling cutter will profile three buckets before it must be removed for sharpening.

During machining, roller steadyrests Fig. 8, brace the work-piece against the thrust of the cutter. At the end of each table pass the steadyrests back off while the work indexes, then return to contact the bucket and lock in position for the next pass. The cutter is liberally flooded with Cimcut cutting oil (Cincinnati Milling Machine Co.) that has a 175 viscosity rating. This sulphated and chlorinated lubricant, plus certain additives, prevents welding of chips to the cutter bit faces and also contributes importantly to achieving an excellent surface finish.

Dimensional repeatability on the order of  $\pm 0.002$  to 0.003 inch is maintained by the system. Errors traced to cutter wear and work-piece deflection may total somewhat greater values.

Only one operator is needed to keep four bucket milling machines going, Fig. 1, and this man has sufficient free time to operate an automatic cutter grinder.

Of no small significance in this application of numerical control to turbine-bucket milling is the drastic cut in lead time made possible. Engineering changes in the part can be introduced in a matter of days, instead of weeks, by substituting punched cards or making new tapes. New designs can be developed and programmed in a couple of days. Manufacturing lead time is thus reduced from many weeks to the short time needed to prepare and process the data from which the tape will be made. Fixturing a Numera-Trol machine is usually so simple as not to be a factor in figuring lead time.



Arranged for boring, the Quartet machine takes a cut on the casting for a model. Note the horizontal milling spindle extending from the back of the turret, extreme right.

## MODELMAKING ON A SINGLE TURRET TYPE MACHINE

WHEN THE GRAY CO., INC., Minneapolis, Minn., began to plan for modernization of its model shop, it discovered that among its equipment requirements was the need for a drill press, a jig borer, and vertical and horizontal milling machines. Several pieces of equipment seemed necessary for these particular functions, but investigation showed that all operations could be performed on a single unit, the U. S. Quartet turret type milling machine, built by the U. S. Burke Machine Tool Co., Cincinnati, Ohio. This machine is capable of milling, drilling, and boring to close tolerances in one setup, without the use of fixtures.

At the Gray Co., the "Quartet" is utilized as a horizontal milling machine for model work. Typical is an example in which it is used with a 6-inch diameter facing mill for squaring up aluminum castings approximately 3 inches thick by 10 inches long. Spindle speed for horizontal operation is infinitely variable from 29 to 1450 rpm, with 250 rpm used for this particular job.

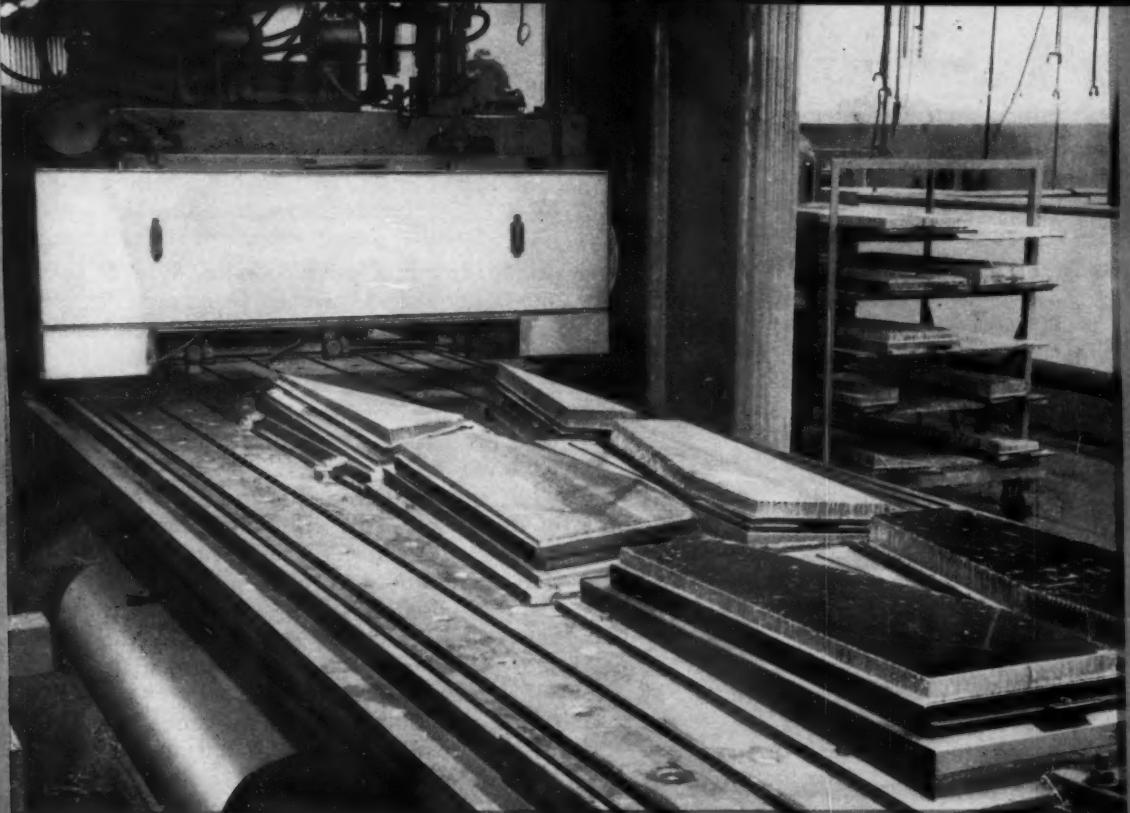
The equipment is also employed for straddle milling, with two cutters spaced as required on a horizontal drive arbor for milling hex- or square-headed bolts. When the machine is used as a universal horizontal miller, the spindle is indexed

to the required angle by means of a worm and worm-wheel that rotates the entire turret assembly, rather than by swiveling the saddle. The table retains its inherent stability, and the turret locks securely at the desired angle.

An example of using the Quartet as a vertical drill press is one in which a dividing head holds a small tubular part in order to drill eight rows of five holes each, 0.040 inch in diameter, equally spaced both longitudinally and diametrically. In this operation, the spindle is run at 2100 rpm. In vertical milling, the company commonly uses an end-mill for cutting slots and keyways.

It takes only sixty seconds to change over from horizontal to vertical operations, accomplished by indexing the turret 180 degrees. The vertical head also swivels 90 degrees for angular drilling or boring. Settings are obtained by worm and worm-wheel, while the ram is positioned by rack and pinion. The vertical head has an infinitely variable feed rate of from 0.002 to 0.008 ipr.

Used in the same model department as a jib borer, this machine made a forty-cavity, injection type rubber mold consisting of three plates with matched holes. Center-to-center distance, as well as the diameter of each hole, had to be accurately positioned and sized.



When honeycomb structures were first designed into aircraft and missiles, the manufacturing problems involved were many. One of these concerned chucking of the paper-thin cells. Several methods of holding the cores are currently being used: for example, ice chucking, resin filling, and mechanical locking. But during contouring, at Temco . . .

## WAX GRIPS HONEYCOMB

RAYMOND H. SPIOTTA  
Associate Editor

IN ONE OF THE COUNTRY'S largest aircraft production regions—the Dallas-Fort Worth area—the Temco Electronics & Missiles Co. is actively engaged in many military and civilian projects. It is producing components for such weapons system as Lockheed's F-104, Boeing's B-52G, McDonnell's F-101, and Raytheon's Hawk missile. Among the products developed and manufactured by Temco are the TT-1 Pinto primary jet trainer and the Corvus air-to-surface attack missile which is intended for use by carrier-based aircraft.

Items such as these require the use of consid-

erable quantities of honeycomb material. One contract in particular—that for wings and elevons for the Hawk—calls for almost all honeycomb sandwich structures. This work is being done in the company's Grand Prairie plant at the western edge of Dallas.

### ***Wax-Filled Platens Locate and Lock Core Material***

Machining of honeycomb core material in quantity called for the adoption of a holding means that would be economical, effective, and



Fig. 1. Water-soluble wax is ladled into dammed area of preheated platen. The wax has a low melting temperature of 145 degrees F.

would fit into a production-line type of operation. The process currently being used has given dependable results. It makes use of shaped platens and wax.

Platens are cut from 1/2-inch-thick aluminum plate to approximately the edge profile of the core. Six of these are needed to accommodate the various sections that make up the Hawk wing, while five more are used for the elevon sections of the same missile. Aluminum strips, 3/8 inch thick, are machined where required and then screwed and doweled to the platen to serve two main purposes. First, they accurately locate the honeycomb core with respect to the platen; second, they serve as a dam to contain the warm liquid wax until it has solidified.

In a preliminary step, the platens are placed in an oven and heated to a temperature of 150 to 250 degrees F. When they emerge they are brought to a heating pot, Fig. 1, where melted wax is ladled into the cavity. Carbowax 6000 is used in this process. It is a water-soluble wax that melts at 145 degrees F. and solidifies at 110 degrees F.

With the platen still at the melting pot the honeycomb core is carefully positioned on it, Fig. 2, and pushed down into the liquid wax. The core is a snug fit within the retaining strips for reasons of positive location. To assure positive contact between the bottom of the work and the surface of the platen while the wax hardens, the assembly is placed on a table where bags of lead shot are laid on top of the core as shown in Fig. 3.

Solidification of the wax is accelerated by subjecting it to a reduced temperature. The platen is transferred to a roller table and pushed into a refrigeration unit, Fig. 4. Here it is allowed to cool for thirty minutes. Actually, the temperature of the platen is not lowered drastically. All that is necessary is that it be brought down quickly to 100 degrees F., which is well below the point at which the wax hardens.

#### Mounted Cores Are Roughed and Finished at the Same Time

Cutting of the honeycomb is done on a planer that has already seen many years of service. How-



Fig. 2. Honeycomb is positioned within retaining strips on platen; pressed down into the liquid wax. Strips provide positive location of core.

ever, the machine has been rebuilt to handle its new role effectively. For one thing, an Onsrud milling head is supported by the cross-rail and drives an 18-inch-diameter "baloney slicer." Another change is the addition of a band saw behind the cross-rail, between the two upright columns. Also, the modified planer is equipped with General Electric controls for template-guided machining.

Platens containing the honeycomb cores to be cut are lined up in two rows along the planer table. The bases supporting the platens are so angled as to yield properly contoured surface sections during a pass that is straight with regard to cutter-table relationship.

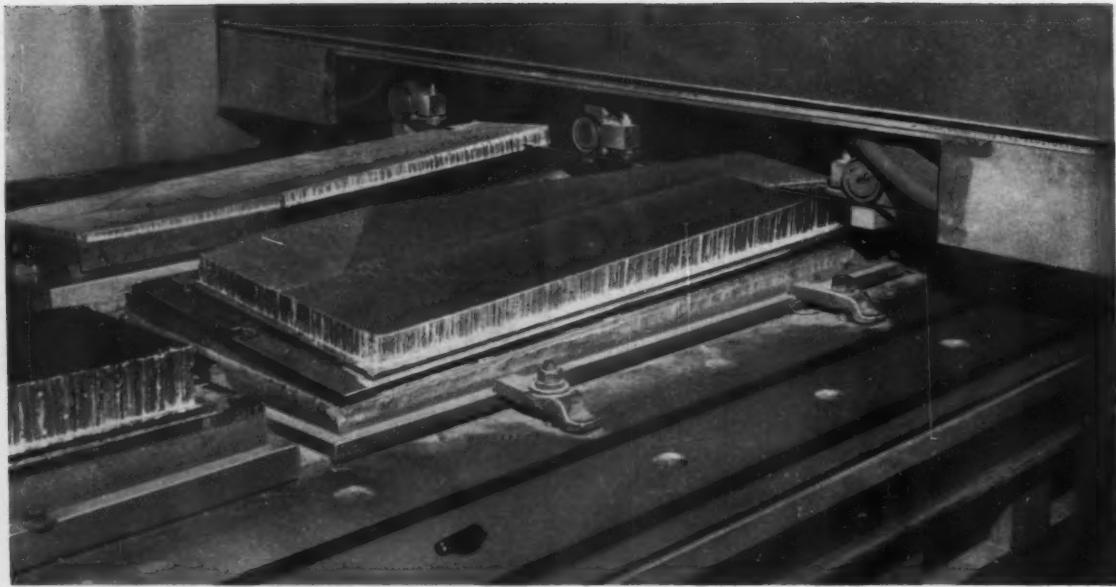
As the table carries the platens toward the columns, contact is first made between the core material and the band-saw blade, Fig. 5. In this rough-cutting operation the surface of the honeycomb is brought to within 0.030 inch of desired size. Continuing past the columns, the work is engaged by the disc cutter, Fig. 6, where its top surface is trimmed to final dimensions. The 18-inch-diameter disc cuts only two-thirds the width of one line of cores in a single pass; although the band saw, which extends across the entire table, roughs both lines. This means that two additional passes are necessary to finish the surfaces of both lines of cores—a total of three passes. The platen remains fixed on the table while all three passes are made.



Fig. 3. With the wax still in liquid state, shot bags are distributed over the core surface to assure positive contact between platen and core.

Fig. 4. Bagged honeycomb is slid into refrigerator to accelerate solidification of wax. Platen temperature need only be reduced to 100 degrees F.



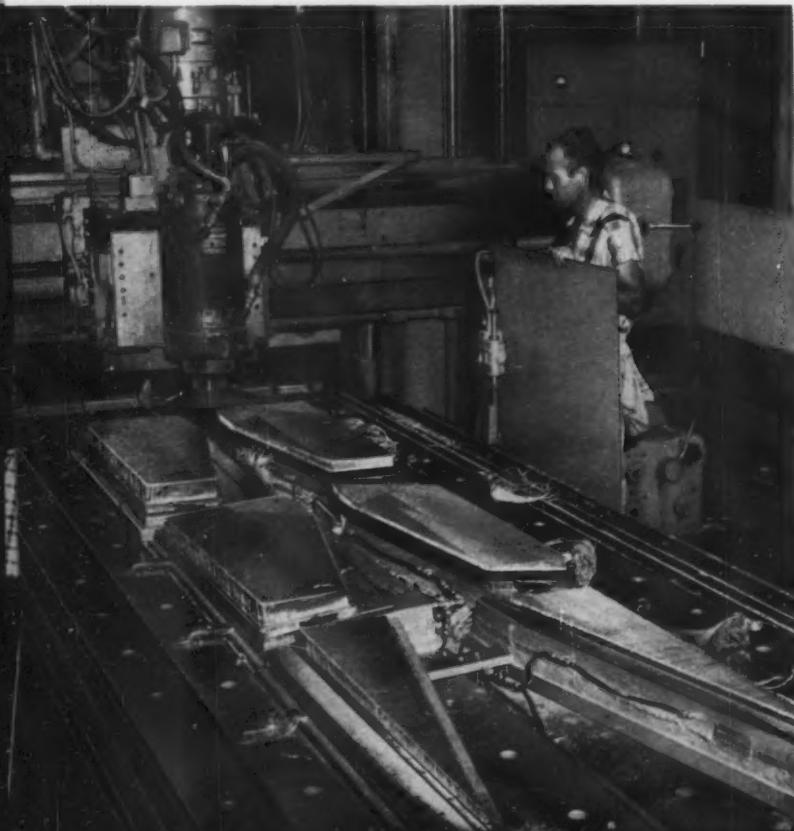


#### **Honeycomb Remounted to Work Opposite Surface**

Depending on the angle at which the core is presented to the band saw and disc cutter, only one section of the surface of the work, as already mentioned, will be roughed and finished. The number of these individual surface sections determines how many times work must be reposi-

tioned on the machine table, and subjected to the combined roughing and finishing passes. One component of the missile wing has two surface sections on each side; therefore four cutting operations are necessary.

During all the setups necessary to complete one surface of the work, it should be pointed out, the honeycomb remains locked in its original platen. When it comes time to machine the op-



**Fig. 5. (Above)** Platens are angularly positioned for contouring on converted planer (see also heading). Honeycomb first contacts band-saw blade which roughs it to 0.030 inch of size.

**Fig. 6. (Left)** Eighteen-inch-diameter baloney slicer is mounted back-to-back with band saw. Tools cut simultaneously to rough and finish honeycomb.

**Fig. 7.** Core must be remounted to permit machining of the other side. In preparation, the platen and honeycomb are placed in an oven to melt the wax.



posite side of the work, however, it must be remounted to expose its flat face.

Remounting is a simple task. The platen and the core are placed in the same oven previously used for preheating, Fig. 7.

For a period of thirty-five to forty minutes the platen and core soak at a temperature of 200 degrees F. During this time the wax melts. When the core is loosened from its bond and removed from the oven the operator picks it up with asbestos gloves, Fig. 8, and places it on a mesh grid. Here, an air hose is used to blow off excess wax.

Both honeycomb and platen are placed in a wire basket and submerged in a tank containing hot water and detergent at a temperature of 175 degrees F. This setup cleans the platens sufficiently so that they are ready for their next run.

Then the honeycomb is fitted into a second-operation platen having a mounting surface that is, of course, contoured to match the configuration of the core surface just machined. The second platen goes through exactly the same series of steps as the first platen, including melting and cleaning. The honeycomb, however, must undergo an additional prebonding cleaning procedure after it has been completely machined.

It should be mentioned that rarely does a current process, no matter how satisfactory, prove to be the ultimate. Behind-the-scenes research is constantly going on to arrive at improved methods. So it is with the subject of this article. Temco is, at this time, working on other means of gripping honeycomb for machining which it hopes will surpass that already described.

**Fig. 8.** Honeycomb core is being removed from heated platen after all machining has been completed on all surfaces. Bath of hot water and detergent removes wax.



# MATERIALS

The properties and new applications of materials used in the mechanical industries

## High-Tensile Alloy-Steel Bar that Eliminates Heat-Treating

A high-tensile strength alloy-steel bar that takes the place of quenched and tempered bar steels, and eliminates heat-treating and costly secondary operations, has been made available by the La Salle Steel Co., P. O. Box 6800-A, Chicago 80, Ill. Called e.t.d. 150, it is high in strength—guaranteed minimum 150,000-psi tensile strength and a guaranteed minimum hardness of 32 Rockwell C—yet machines readily as compared to other alloy steels of similar hardness. It has been successfully roll-threaded, and provides satisfactory finish and tool life.

The steel is a 4100 series, 0.40 minimum carbon-alloy steel bar, and because of the individual processing of each bar and the inherent process characteristics, good uniformity and control of properties are achieved.

Available in rounds 7/16 inch through 3 1/2 inches, the alloy-steel bars are recommended for

shafts, gears, pinions, fasteners, axles and other parts to replace heat-treated alloy steels. Tolerances range from 0.005 inch in the smaller sizes to 0.008 inch in the larger. It may be ordered in either standard "as drawn" finish, or ground and polished finish.

## Spring Wire for Service of 600 to 1000 Degrees F.

A precipitation-hardening austenitic alloy, known as NS-A286, has been announced by National-Standard Co., Niles, Mich., for spring wire used in a temperature service range of 600 to 1000 degrees F. The material is finding initial application in jet engines and gas turbines.

The spring material is said to experience as little as half the per-cent-relaxation loss at 1000 degrees F. as comparable alloys at 850 degrees F. (0.080-inch samples subjected to 40,000-psi stress for ten days). It has the following composition: nickel (24 to 27 per cent), chromium



"Flamescent," a Fiberglas lamp that gives the appearance of a gas flame in an electric bulb, is shatterproof as compared with an ordinary electric lamp. Both bulbs were dropped onto a hard surface from a height of over 5 feet. The new bulb, a product of Duro-Test Corporation, North Bergen, N. J., may also be dunked (while hot) into ice water and will remain lighted. A cooling chamber shown underneath keeps the filament operating temperature low, eliminating brittleness and assuring long life.

(13.5 to 16 per cent), titanium (1.75 to 2.25 per cent), manganese (1 to 2 per cent), molybdenum (1 to 1.5 per cent), silicon (0.4 to 1 per cent), aluminum (0.35 per cent, max.), vanadium (0.1 to 0.5 per cent), carbon (0.08 per cent, max.), phosphorous (0.04 per cent, max.), sulphur (0.03 per cent, max.), boron (0.001 to 0.01 per cent), and iron (the balance).

Typical tensile properties for annealed 0.080-inch specimens of this material are 103,500 psi as drawn and 176,000 psi after sixteen hours at 1350 degrees F.; for 15 per cent reduction, 122,500 psi as drawn and 190,000 psi after sixteen hours at 1350 degrees F. Tensile properties for 30-per-cent reduction are 150,000 psi as drawn and 198,000 psi after sixteen hours at 1350 degrees F. Fifteen per cent is recommended for automatic coiling. Annealed or 15-per-cent reduction is recommended for torsion machines.

#### **Weldable High-Strength Steel that is Readily Formable**

Universal-Cyclops Steel Corporation, Bridgeville, Pa., has announced the availability of a high-strength steel for the aerospace industry. "Unimach UCX2," as it is called, was developed specifically for high-performance rocket-motor cases for missiles. It is a modification of AISI 4100 series type steel through the addition of cobalt as an alloying element.

The steel exhibits yield strength levels of 225,000 psi to 235,000 psi. When properly tempered to the above strength levels, the alloy shows essentially no susceptibility to notch sensitivity, one of the prime problems in the produc-

tion of rocket-motor cases. It has good forming and weldability characteristics which facilitate fabrication of these difficult parts.

The material is being offered in all product forms. It may be obtained as an air-melted material under carefully controlled melting practices or as a consumable-electrode vacuum-melted material. Vacuum melting increases the quality level and consistency of the material through refinement and improved cleanliness.

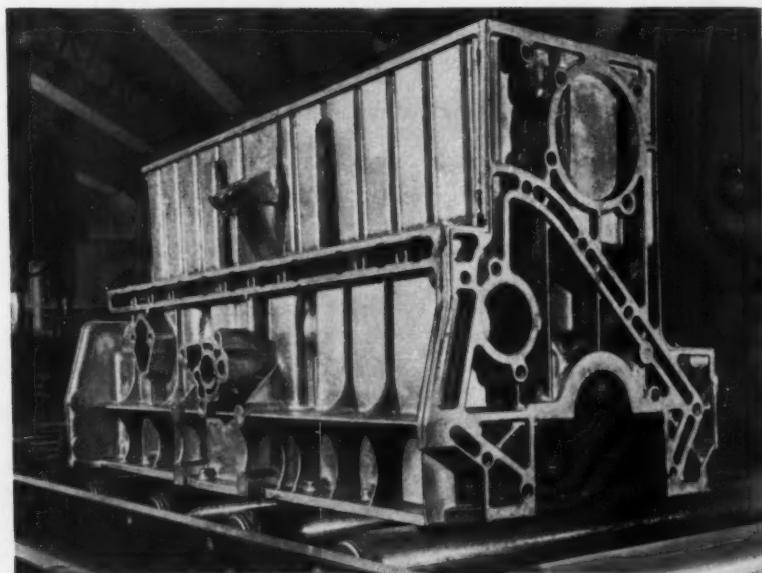
#### **Alkaline Deburring Compound for Use in Tumbling Barrels**

A compound that combines moderate alkalinity with abrasives to deburr metals in tumbling barrels has been introduced by Oakite Products, Inc., 126 Rector St., New York 6, N. Y.

Oakite FM 182, as it is called, incorporates 40- to 80-mesh abrasive to speed cutting action, and so shorten deburring cycles in the finishing operation. It has no adverse chemical action on metals and, in fact, often enhances the color of the pieces. The compound may be used in a range of 4 to 48 ounces per gallon of water, at room temperature, and for times varying with the nature of the work. It is particularly recommended for severe cutting-down operations.

#### **Graphitized Dry Lubricant in a Sprayable Suspension**

A graphitized molybdenum-disulphide dry lubricant, identified as Perma-Slik, has been developed by EverLube Corporation, 6940 Farmdale Ave., North Hollywood, Calif. This compound,



This aluminum die casting, the first of its kind, is a six-cylinder engine block made for American Motors Corporation by Doehler-Jarvis Division, National Lead Co., 111 Broadway, New York 6, N. Y. It contains 53 pounds of aluminum and 14 pounds of gray iron in the form of cast-in liners.

in a sprayable suspension, provides a dry, hard, permanently lubricated surface. The lubricant will stay bonded to the surface even under conditions of extreme pressure and temperature. It will not wash off.

The dry lubricant operates at temperatures as low as minus 300 degrees F. and as high as plus 500 degrees F. It provides wear protection at pressures as high as 50,000 psi. It can be applied to steel, copper, brass, nickel, aluminum, magnesium, plastics, and wood; in fact, any wear surface. Suggested applications include machine tools and machinery, office equipment, farm equipment, and automotive parts.

#### **Chemical Milling Maskant for Stainless Steel**

Metalworkers engaged in the chemical milling of stainless steel, especially in aircraft and missile applications, now have available to them a maskant or masking solution for the protection of non-milled surfaces. It will resist etchant attack for eight hours at 140 degrees F. and parts may be either dipped or sprayed to form a tough, pliable, rubber-like film thickness of 10 to 12 mils. The maskant can be easily and quickly stripped by peeling it off in large strips or sheets.

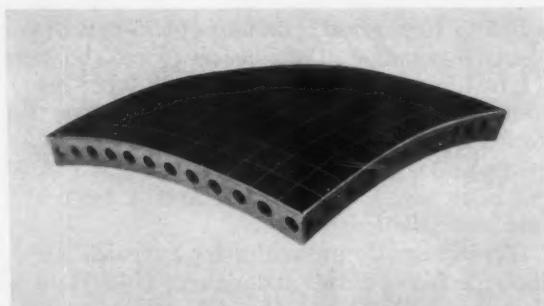
This product, called "Maskant S51K808," was developed by Rinshed-Mason Co., Detroit 10, Michigan.

#### **All-Metal Honeycomb Material with Many Sized and Shaped Curves**

The availability of a contoured all-metal honeycomb has been announced by Allied Research & Engineering Division, 6916 Santa Monica Blvd., Los Angeles 38, Calif. With this material it is entirely feasible to build all-metal contoured honeycomb structures with any number or shape of curves, and in almost any size. Generally, there is no limit as to radius of curvature, nor is there any restriction on how close together the compound curves might be. In other words, designers may now call for all-metal honeycomb structures in whatever shapes best suit their particular requirements.

The material, presently available in nickel of a high degree of purity, has good heat and corrosion resistance, and in general may be used where stainless steel is ordinarily specified. Its heat-resisting properties are limited only by the physical properties of the nickel, which has a melting point of 2651 degrees F.

Skin and cell walls can be as thin as 0.0005 inch. At the same time, the thickness of the skin has no bearing on cell-wall thickness, or vice versa: a cell-wall thickness of 0.0005 inch is en-



**This contoured all-metal honeycomb may have any number or shape of curves and may have a range of skin- and cell-wall thicknesses. It is intended for use in the aircraft, missile, and space-vehicle field.**

tirely compatible with a skin thickness of 1/16 inch, for example.

The material may be manufactured with load-bearing inserts, mounting brackets, etc. Cell size can be varied, either in a single structure or from one portion of material to another, to provide optimum strength-weight characteristics. The material may be welded, using ordinary welding techniques, since there are no low-melting-point constituents. Heat-reflecting barriers may be incorporated in the design.

#### **Line of Epoxy Resins Announced for Tooling and Patternmaking**

The introduction of a complete line of epoxy resins has been announced by Allaco Products, 238 Main St., Cambridge 42, Mass. These compounds have been formulated for the foundry and tooling industries.

One of the line, "Allaco Foundcast 101," has been developed for making epoxy molds and patterns. The compound is dimensionally stable during room-temperature cure, has good machinability, and exhibits easy foundry-mold release and easy draw. This formulation is particularly well-suited for small items where intricate design and surface dimensions are important in the production of the part.

Other compounds of the line, "Allaco Sandbind 201," and "Allaco Facecoat 301," have been formulated for making molds used in casting epoxy duplicates. Molds are stable, have greater durability than plaster, hold corners sharply for retention of detail, and require no wet mixing.

Another product of the line, "Allaco Multicast 401," has been formulated for making epoxy jaws and chucks. It has high resilience and impact strength, a high tensile strength, and good dimensional stability. It cures at room temperature and can be cast in fairly large volumes.

# FILLET-ROLLING DIESEL-ENGINE CRANKSHAFTS

WALTER EGGER, Chief Engineer

Schrader Division, The Foote-Burt Co., Cleveland, Ohio

AT THE FORD TRACTOR and Implement Division, Highland Park, Mich., a single line of machine tools turns out two different crankshafts for both diesel- and gasoline-engine tractors. The operation is unusual in that the diesel cranks are 4145 steel forgings heat-treated to 285-321 Bhn, while the gasoline cranks are shell-molded modular-iron castings. Fortunately, both types have practically the same dimensions: shafts are 25.75 inches long, with four 2.3-inch diameter pins and three 2.5-inch-diameter mains. Throws are identical, since both engines have a displacement of 172 cubic inches.

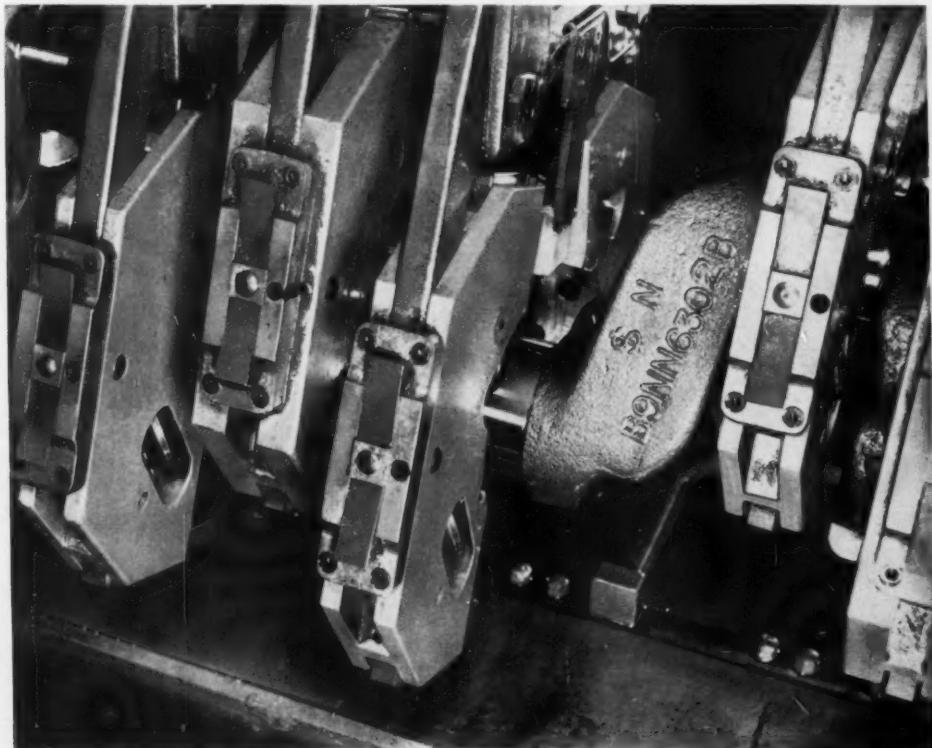
For the initial sixteen operations, both cranks are machined and ground similarly, as is detailed in the accompanying table. The gas-engine cranks are then finished on a Schrader crankshaft-lapping machine, washed, oiled, and made ready for engine build-up.

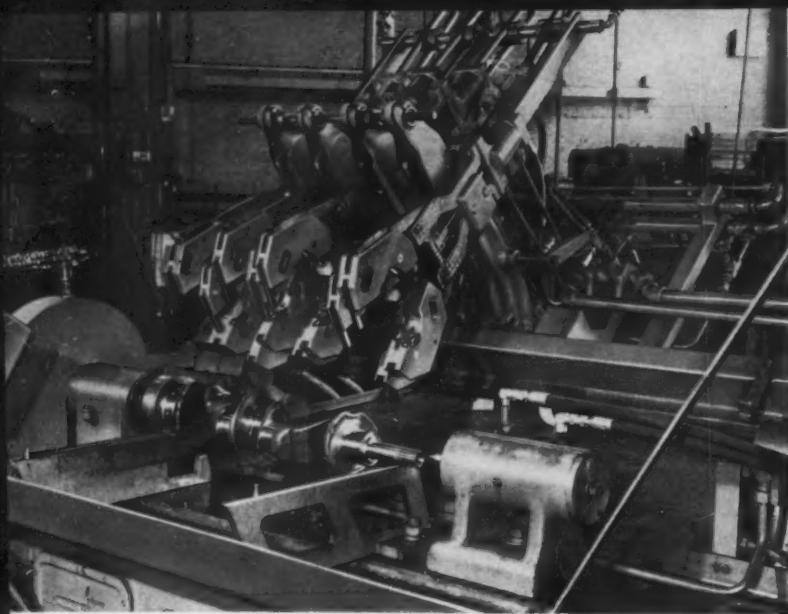
Diesel cranks, on the other hand, are first demagnetized, then washed free of chips. After plugging the oil holes, all pin and main fillets are

rolled on the equipment seen in Fig. 1 (a Schrader fillet-rolling machine). Next, journals on pins and mains are burnished to 10 to 12 micro-inches. Again washed, to remove the fillet-rolling oil, the cranks are coated with an antirust compound and are ready for assembly.

Before machining, materials for both cranks must conform to stringent chemical and microstructural specifications; and during processing, every crank is inspected frequently for tolerance conformance. After lapping or rolling, finish is examined with a Profilometer. Visual inspection assures proper blending of the fillet radius with the journal. Occasionally cranks are tested to destruction to determine hardness in the fillets, journals, and core; also, to check tensile and fatigue properties.

Preliminary studies showed that roll burnishing would produce a high-quality finish on the journals, and that rolling the forged-steel diesel crankshaft fillets would further raise fatigue strength. Ford engineers at first attempted to





**Fig. 1.** Fillet-rolling machine with crankshaft in place. Crank throws match head positions, but hydraulic tailstock has not yet come in. After roller shoes close on journal fillets, clamping arms are released, leaving heads free to reciprocate with throws as crank rotates.

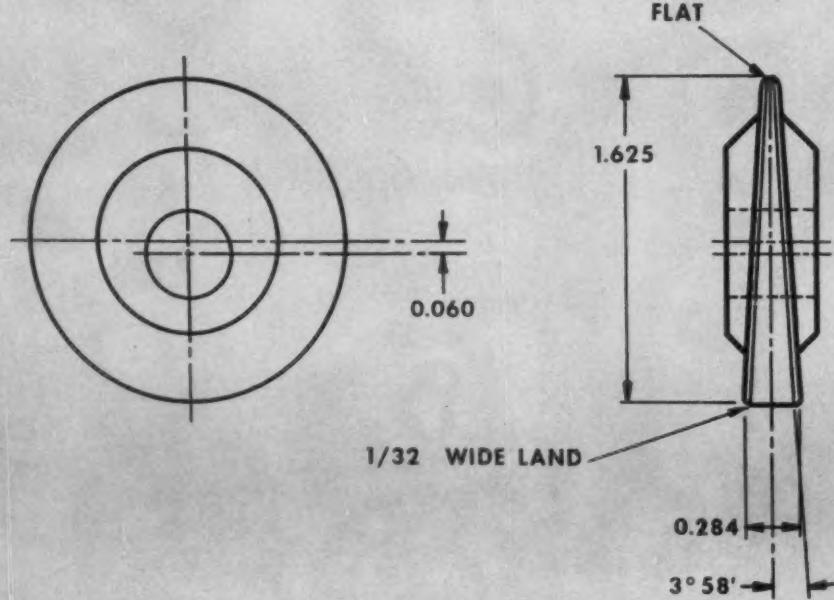
combine the roll burnishing and the fillet rolling in a single operation using a master-crank type of machine. It was quickly found, however, that normal tolerance variations in journal width (distance between the cheeks) and in fillet accuracy precluded rolling fillets and journals simultaneously. Despite the high hydraulic pressure (450 psi) employed, it was barely enough to burnish the fillets and journals, and insufficient to compression-roll them for added fatigue strength.

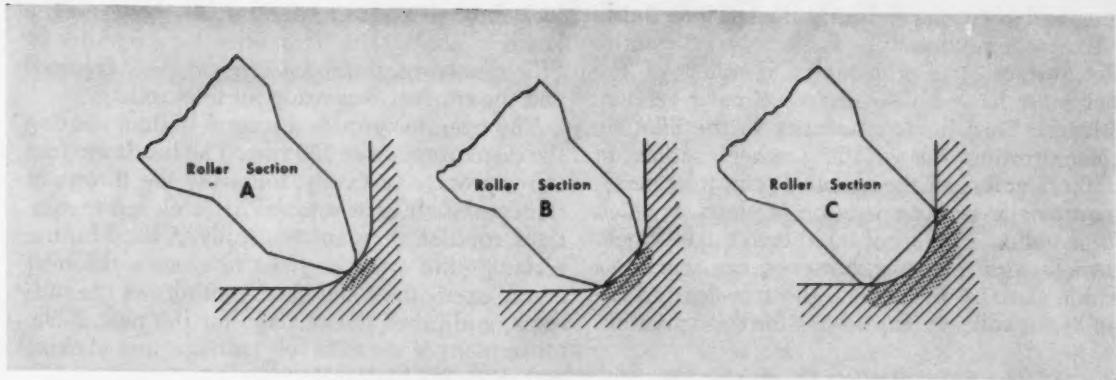
The crankshafts had to have a separate fillet-rolling operation.

#### **Why Fillet-Roll?**

Every fillet is a potential source of fatigue failure. In fact, most fatigue failures occur in these areas. Actual engine and laboratory tests show that crankshafts can withstand higher stress levels after fillet rolling because the fillets are compressed.

**Fig. 2.** Dimensions of the wedge-shaped fillet rollers used. Rollers are of oil-hardening tool steel, heat-treated to 62 to 65 Rockwell C.





**Fig. 3.** Since the wedge-shaped roller is pinned eccentrically in its shoe, it continuously changes its area of contact in the fillet during each rotation.

sively prestressed to counteract tensile fatigue and impact forces. The filler rolling does not have to be very deep, as long as it plastically deforms surface layers of the metal and work-hardens the fillet to a depth of 0.0001 to 0.0005 inch or more. The rolling increases hardness from 34 to as high as 55 Rockwell C (as converted from superficial hardness scale). In addition, the kneading action of the rollers improves surface finish, from 30 to 12 micro-inches or less. Because of this high surface hardness and smooth finish, deep hardness penetration is not needed.

To deform metal plastically takes high compressive force. Yet the Schraner equipment achieves this by applying relatively low hydraulic pressure to an eccentric, wedge-shaped roller having a small contact area (Fig. 2). As the roller rotates on its pin axis, following the fillet, the narrow portion of the wedge rolls metal at the fillet center (Fig. 3, A). Rotation away from

the wedge point works fillet metal toward its extremities (Fig. 3, B and C). Beyond the wide zone the wedge roller again works the fillet metal toward its center.

As the shaft and roller rotate in contact, narrow lands on the roller circumference ride up and down each side of the fillet in a sort of kneading action. Only a few cycles are needed to roll the entire fillet thoroughly. Floor-to-floor time is but twenty-six seconds per crank. Fig. 4, a close-up view of the machine, shows how the rollers are pinned to their shoes.

Contact area of each roller is about 0.00027 square inch, so that an applied pressure of only 175 pounds produces a compressive shear stress of 650,000 psi to cause metal flow. Rolling with a ball or a plain roller shaped to match the fillet radius would demand much higher applied pressure because the contact area would be greater. A light oil lubricant prevents galling at these pres-



**Fig. 4.** Four rollers are mounted in each two opposed roller shoes, which close on the crankshaft journal. The pin-mounted rollers are free to shift laterally 0.015 inch to compensate for variations in journal width. They are diametrically opposed in the two journal fillets; at 45 degrees to the crankshaft axis when shoes are closed.

sures, and assists in producing an even finer finish.

To assure uniform roller contact over the entire fillet surface, the preparatory grinding of the fillet must have a near-perfect circular section. Although Ford holds circularity in the fillet by profile-dressing the grinding wheel radius to  $\pm 0.0025$  inch (half the specified print tolerance), an automatic truing operation is planned which will maintain a radius of 0.120 inch  $\pm 0.001$  inch. Journal-width tolerance, however, can remain as flexible as 0.015 inch, since the free-floating action of the rollers compensates for this variation.

### The Fillet-Rolling Operation

To roll the fillets, the operator roughly positions one end of the crankshaft in the headstock of the machine, while the other end rests on a rail, as can be seen in Fig. 1. By means of a mark on the spindle, he aligns the throws with seven prepositioned heads. Each head has a pair of arms which carry the roller shoes. The cycle starts by pressing a button which lowers a carriage to locate the shoes on their respective pins and mains. Meanwhile, the tailstock moves in to center the shaft, engaging it with a locating pin in the driver spindle. When nylon bumpers in the throat of each head strike the journals, the shoes close and

lock through a scissors linkage, as shown in the heading illustration. This presets each roller to 175-pound pressure. Arm clamps are then released and the crankshaft is ready for fillet rolling.

The operator presses a second button, starting the crank rotation at 150 rpm. The heads are free to reciprocate vertically, following the throws of the crankshaft as it rotates. After eleven revolutions, rotation stops automatically. A third button reclamps the arms in place to receive the next crank, opens the roller shoes, withdraws the tailstock, and raises the carriage for the next cycle. Movements of the tailstock, carriage, arm clamps, and shoes are hydraulic.

When the shoes close, jets of a lard-base coolant oil from a row of nozzles mounted in the machine table spurt upward to lubricate the fillets and rollers. Flow shuts off when the shoes reopen.

If the work-piece is incorrectly positioned, the operator can safely raise the carriage to nest it properly. What is more, the relatively low hydraulic pressures employed prevent damage to rollers, shoes, and slides in such an eventuality.

Occasional replacement of the wedge rollers is the only maintenance necessary. Ford has experimentally processed as many as 15,000 cranks on one set of rollers, but in production, rollers are reground generally every 1000 cranks.

### MACHINING OPERATIONS ON DIESEL- AND GASOLINE-ENGINE CRANKSHAFTS

- Operation 1: Mill locating pads.
- Operation 2: Turn gear diameter and vibration damper.
- Operation 3: Rough-turn mains at 65 rpm with high-speed steel form tool, holding 0.123- to 0.127-inch radius in fillets and 90-micro-inch finish.
- Operation 4: Rough-grind mains, holding 0.005-inch tolerance on centers and 0.123- to 0.125-inch radius in fillets and 25-micro-inch finish.
- Operation 5: Finish-grind mains, holding 0.110- to 0.120-inch form radius in fillets and 15- to 30-micro-inch finish.
- Operation 6: Precision-grind center-main width for locating surface.
- Operation 7: Drill, ream, and tap all holes except oil holes.
- Operation 8: Turn pin diameters, locating from mains; four pins simultaneously.
- Operation 9: Drill four 1/4-inch oil holes and five 3/16-inch oil holes 4 1/2 deep.
- Operation 10: Grind shaft output end.
- Operation 11: Cut splines.
- Operation 12: Grind flywheel outside diameter.
- Operation 13: Hob timing gear.
- Operation 14: Check dynamic balance and drill balancing holes, holding balance within 0.3 inch-ounce.
- Operation 15: Polish center-main face.
- Operation 16: Shave gear.

## TOOL ENGINEERING

# Ideas

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

### Gage Checks Concentricity of Threaded and Reamed Holes

ROGER ISETTS, Kenosha, Wis.

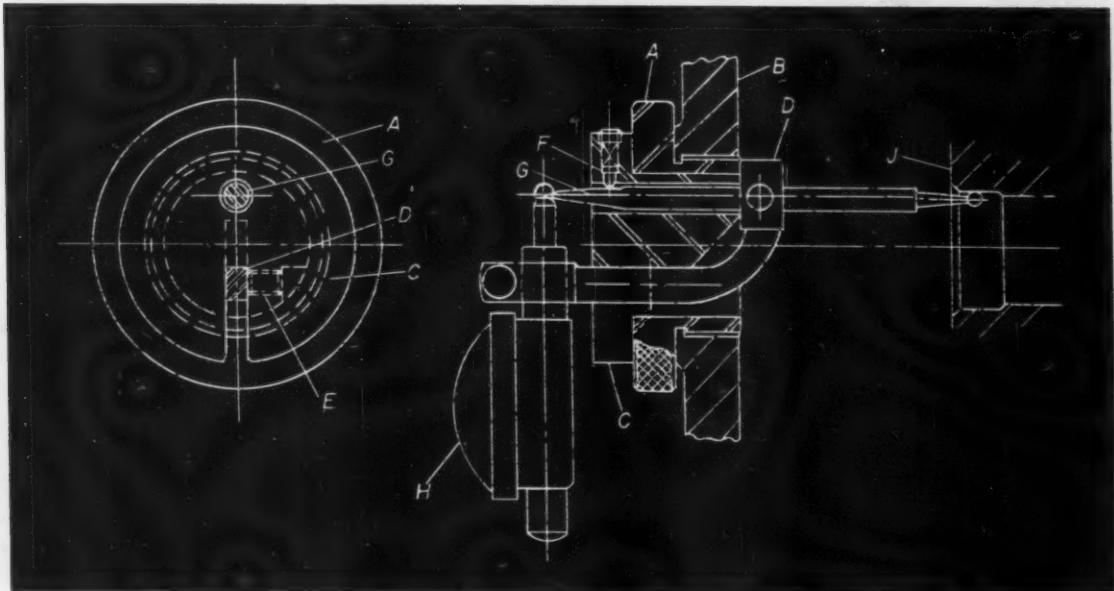
An interesting gaging setup was designed to check the concentricity between a threaded hole in an outside wall and a reamed hole in an inside wall. Since the hole being checked was partially hidden, one of the major considerations was that the gage be read from the outside. Illustrated is the unit that was designed for this particular job. Construction cost was small, as was the time required for its use.

Basically, the gage body consists of two bushings. Outer bushing A is made from SAE 3150 steel that has been hardened to Rockwell C, 42 to 50. It has a male thread accurately ground to fit the female thread in outer wall B of the work-piece, in this case a 1 1/2-18 NEF-3 thread.

A central hole in the bushing is ground to a slip fit with inner bushing C. This bushing, made of hardened and ground tool steel, contains a through hole and a milled slot to receive a standard dial-indicator hole attachment D, which is secured with headless set-screw E. Spring plunger F maintains constant pressure against stem G of the hole attachment to keep it in contact with the stem of a standard, flat-back dial indicator H.

In use, bushing A is threaded into the work-piece by hand. As this is done, the end of stem G enters the reamed hole in inner wall J. Bushing C is then rotated, and the eccentricity of the reamed hole can be obtained by direct reading of the dial indicator.

Concentricity of threaded hole in wall (B) and reamed hole in wall (J) can be quickly checked with this simple gage. With bushing (A) threaded into the outer wall, bushing (C) is rotated and eccentricity is noted on dial indicator (H).



## Lathe Faces Thin Brass Discs

F. MURRAY, Chicago, Ill.

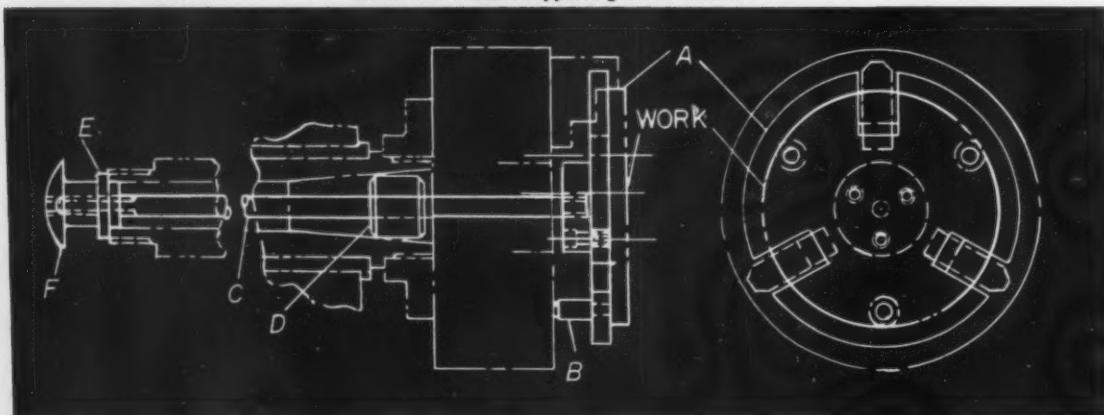
Several thousand brass castings—8 inches in diameter by 9/32 inch thick—were needed, faced to a flatness of 0.005 inch. The supporting plate shown in the diagram enabled them to be held in a three-jaw chuck for machining within the tolerance by backing up the work all over.

The steel support plate A, has both sides ground. For rests, three shoulder pins B, of equal height, are press-fitted into the back of the plate and ground flush on the front. Three slots for jaw

clearance are provided through the plate. On the back, in the center, a draw-rod flange is mounted with screws.

The draw-rod C is supported at its center by a sleeve D within the spindle, and by a flanged washer E at the rear, where there is a hand knob F threaded to the draw-rod to provide holding tension. Before using the support plate, the face of the chuck was checked for runout. This was found to be so slight that truing was unnecessary.

Low-cost support plate built into three-jaw lathe chuck enables thin brass discs to be accurately faced on both sides in a standard lathe chuck. The section view at the left shows the washers supporting the draw-rod.



## Clamping Plunger Applies Controlled Pressure Outside of Operator's Influence

F. C. ELMO, Dayton, Ohio

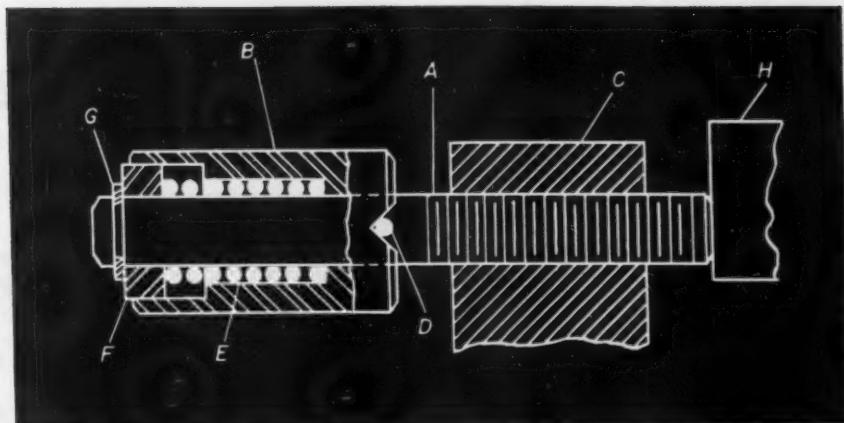
Setups in which work must be secured lightly with a preset amount of pressure can include one or several of the clamping plungers illustrated. The two main elements of the device are torque screw A and barrel B. An important advantage of this device is that the pressure applied is not controlled by the operator; therefore it is always the same from piece to piece, and from operator to operator.

Fixed to the jig, fixture, or machine table is a

block C having a tapped hole which engages the torque screw. Pin D is a press fit in a hole cross-drilled in the torque screw a short distance behind its threaded section. The barrel encloses the torque screw, and has a V-groove milled across its face. Inside, the barrel is bored to receive spring E and also counterbored to receive ring F, which is retained in position near the end of the torque screw by clip G.

To clamp the work H, the barrel is rotated.

Torque screw A and barrel B rotate as a unit until pressure against the work H stalls the torque screw, thrusting the barrel back.



Since the spring keeps the V-groove over the pin, the torque screw is forced to rotate as a unit with the barrel, and is advanced through the block. Then, when continued movement of the torque screw against the work builds up sufficient pressure, the barrel is thrust back, and the

pin rides on the face of the barrel. Thus, the torque screw remains stationary as the barrel is rotated further.

If, after the clamping plunger is constructed, it is decided to increase or decrease the pressure on the work, another spring can be used.

## Vise Supported from Dividing Head for Compound-Angle Milling

H. J. GERBER, Stillwater, Okla.

A shell end-mill arbor and an adapter block can be used to support a small drill vise on the spindle of a universal dividing head. Such a setup is helpful in milling compound angles on small tool and gage components, particularly of the type illustrated in Fig. 1.

The arbor and block appear separately in Fig. 2.

On its top, the block has a channel which receives the base of the vise. Set-screws in one wall of the channel lock the vise in position. The bottom of the block has a slot which fits the two driving lugs of the arbor. A cap-screw runs through a counterbored hole in the center of the block, securing it to the end of the arbor.

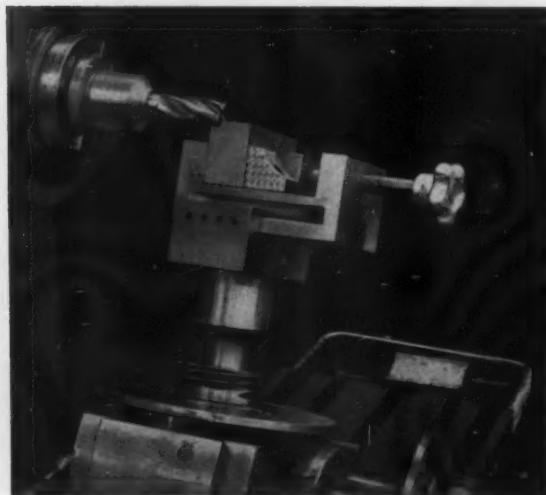
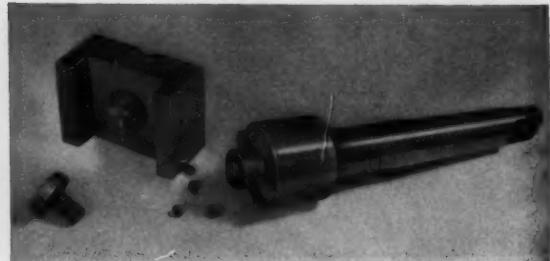
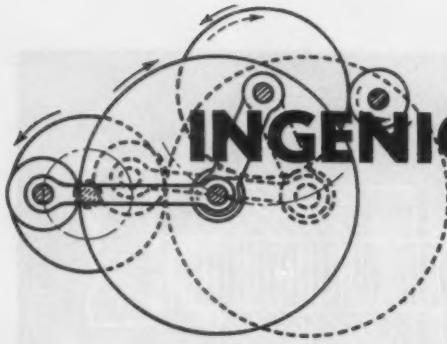


Fig. 1. (Left) A compound angle is milled in a work-piece held in a vise, which, in turn, is supported from a dividing head.

Fig. 2. (Below) This special adapter block and standard shell end-mill arbor support the vise on the spindle of the dividing head.





# INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

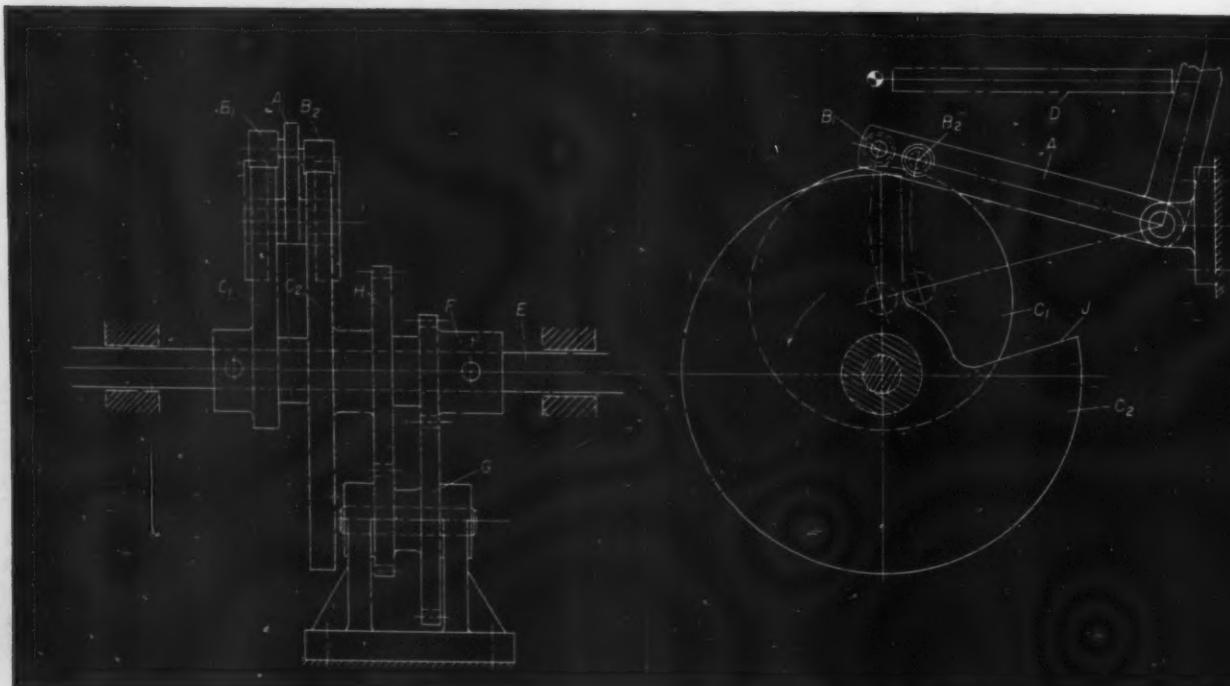
## Intermittent Motion from Two Synchronized Cams

PREBEN W. JENSEN, South Norwalk, Conn.

Packaging machines often require mechanisms to transmit a particular motion during each fifth revolution of the main camshaft. Such a need might arise where five packages are to be grouped, then pushed from the machine at the same time. A mechanism that has been arranged to satisfy these particular requirements is shown in the accompanying illustration.

Principal operating elements of this mechanism are two synchronized cams and one follower-lever. The upper end of single, L-shaped lever A drives the package-ejector unit (not shown). At the opposite end of the lever are two follower-rollers  $B_1$  and  $B_2$  which are held in contact with cams  $C_1$  and  $C_2$ , respectively, by a spring D (attached to the upright lever arm).

Lever (A) is permitted to function only once for each five revolutions of camshaft (E). This intermittent movement is controlled by the action of two synchronized cams ( $C_1$ ) and ( $C_2$ ).



Cam  $C_1$  is pinned directly to the constantly rotating camshaft  $E$ , while the motion for cam  $C_2$  is obtained indirectly from a gear  $F$ , also pinned to the camshaft. By means of gears  $G$  and  $H$ —the latter being keyed to cam  $C_2$ —movement of gear  $F$  is reduced to one-fifth by the time it reaches the second cam. Thus, the speed of cam  $C_2$  is only one-fifth that of the camshaft and  $C_1$ , although the rotational movement of both of the cams is in the same direction.

Bearing this in mind, and noting the cam configurations and positions in the right-hand view, it can be seen that in one revolution of cam  $C_1$

cam  $C_2$  will rotate a distance equal to the width of its cutout  $J$ . This cutout occupies approximately one-fifth of the otherwise circular cam.

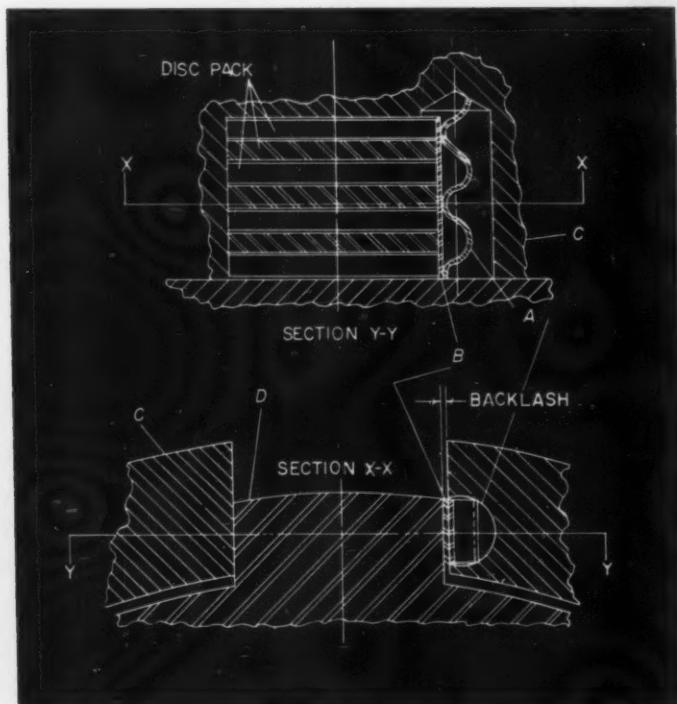
During this rotation of the camshaft, follower-roller  $B_2$  is disengaged from the surface of cam  $C_2$ . This permits roller  $B_1$  to track along the entire surface of cam  $C_1$ , thus causing lever  $A$  to pivot. For the next four rotations of the camshaft, follower-roller  $B_2$  will ride along cam  $C_2$ , thereby preventing roller  $B_1$  from being affected by the contour of cam  $C_1$ , and causing lever  $A$  to remain motionless. Of course, many variations of this mechanism are possible.

## Wave Springs Eliminate Backlash in Disc Drives

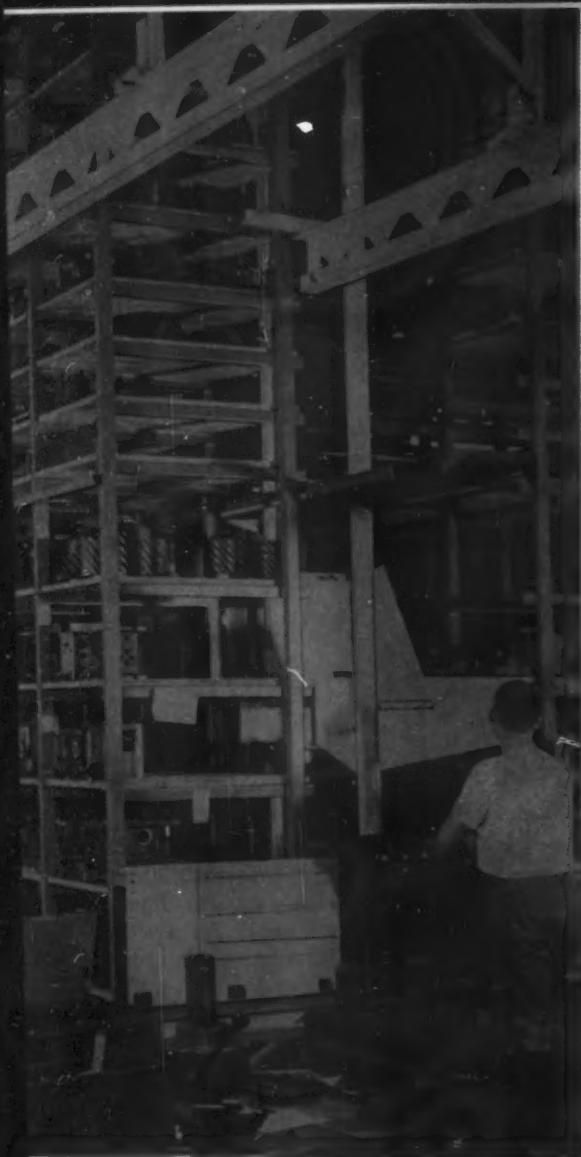
GEORGE PHEIL, Racine, Wis.

An arrangement to eliminate backlash in disc type drives and clutches is here illustrated. In such devices, a wave spring  $A$  can be brazed at one end to a flat steel plate  $B$  and installed in a recess machined in the hub member  $C$  as shown. Member  $B$ , which bears against the lugs of the

disc elements  $D$ , takes up the backlash in the assembly and serves to dampen vibrations that may occur during operation. To increase the effective spring action, a series of these wave springs may be employed at equal angular intervals around the disc assembly.



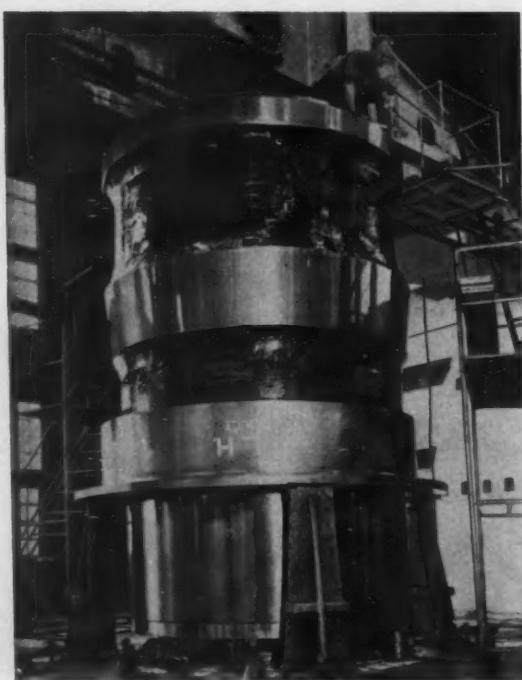
Wave springs arranged in this manner will eliminate backlash and dampen vibration in disc type drives.

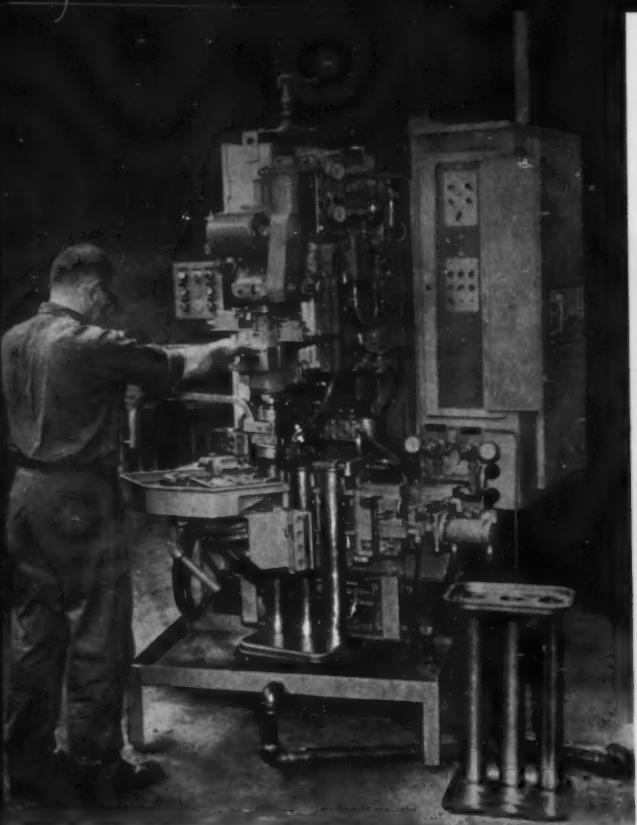


## In Shops Around the Country

**TOOL PARKER**—Borrowing the concept of the automatic car garage, a Triax Retriever system is providing push-key storage of jigs, fixtures, and special cutters at the New Philadelphia, Ohio, plant of Warner & Swasey. The unit controls a 78-foot long aisle with 768 floor-to-ceiling storage positions arranged 16 feet high on each side. In the same cycle, the electrically operated carrier can store one load and return with a different load.

**TURNING POINT**—Machining the pintle for the Navy's "Big Dish" rotating radio telescope, at Baldwin-Lima-Hamilton, Eddystone, Pa. The shaft weighs 120 tons, is 9 feet in diameter, and 15 1/2 feet high. A giant reflector having a diameter equal to the length of two football fields will revolve around the pintle to scan from horizon to zenith through 360 degrees.





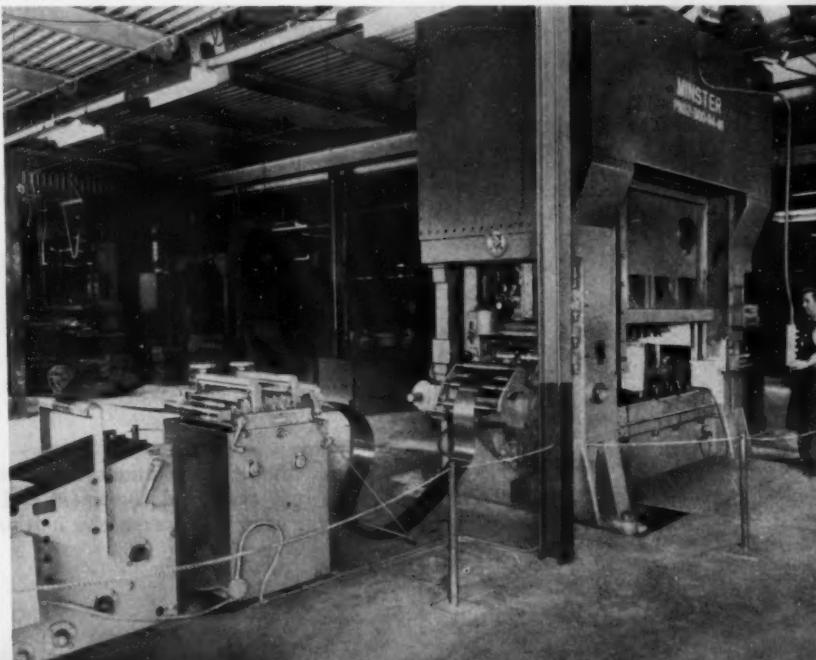
**WOBBLE WELDER**—for joining tubing to end panels of its heat exchangers, Motor Wheel Corporation, Lansing, Mich., uses this special Precision welder to produce a circular seam. The unusual welding head is shaped like a cup.

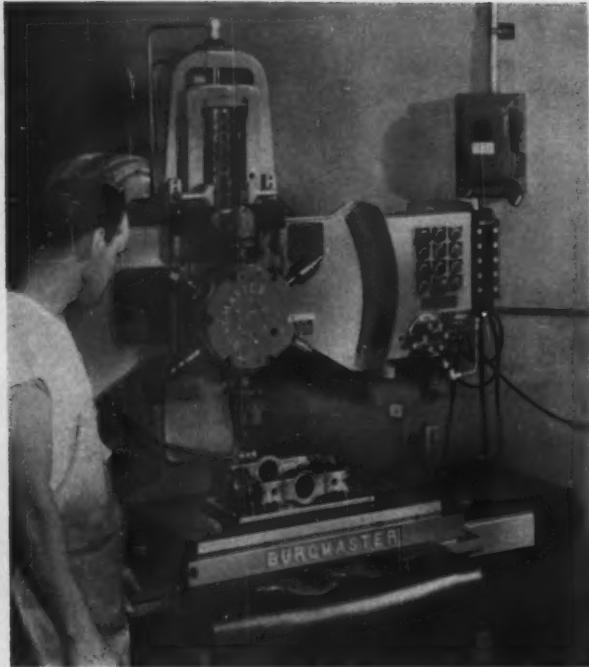
An eccentric drive rocks the cup electrode and rotates it on edge with a rolling motion around the periphery of the weld. Tube diameter was too small for a conventional circular seam welder, too big for a ring projection welder.



**CLASSIC SIX**—American Motors' 1961 Classic Six features an aluminum in-line engine block, here being pressure-tested following die casting, at Doebler-Jarvis Division, National Lead Co., Toledo, Ohio. Block weight of 67 pounds consists of 53 pounds of aluminum and 14 pounds of centrifugally cast iron cylinder liners. The liners are mechanically bonded to the aluminum. Liner inserts and camshaft cores are installed and removed from die automatically.

**CONE MAKER**—This Minster 300-ton Progress-O-Matic straight-side press is the kingpin of a new method of manufacturing loudspeaker cone housings, at the Paducah, Ky., plant of the Magnavox Co. The press, which turns out 1800 parts per hour, is toolled with five- to seven-station progressive dies, and is equipped with a straightener and double-roll feed. It replaces seven smaller presses which were hand fed and yielded only 625 parts per hour.





## COMPLEX, SHORT-RUN PARTS—A NATURAL FOR TAPE CONTROL

THE FACT THAT numerical control can be advantageous to medium- and small-sized shops, as well as large plants, becomes more apparent every day. For example, the Mechanical Specialties Co., Los Angeles, Calif., employs tape-controlled equipment for performing various types of machining operations. One of the important tape-controlled machine tools in this plant is the Burgmaster turret drilling machine seen in the heading illustration.

Among the wide variety of small-lot jobs on which this machine is used are many precision missile components. A typical work-piece is the computer rail shown in Fig. 1. This part has fifty accurate holes which formerly required the use of a costly indexing fixture. They are now center-drilled, drilled, counterbored, chamfered, and bored by the turret drilling machine at the rate of 1.7 hours per part, using tooling that required only eight man-hours to build.

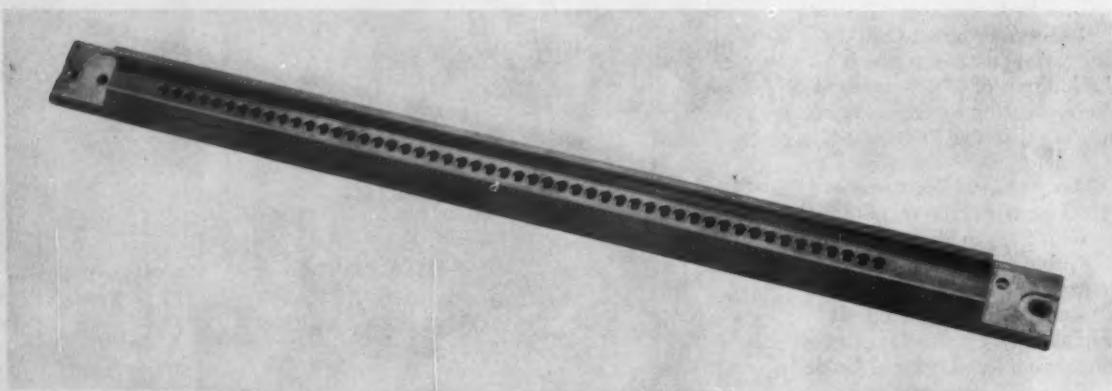


Fig. 1. Fifty holes, each requiring five operations, are machined in this steel computer rail. The use of tape-controlled equipment and relatively simple tooling eliminated the need for an expensive indexing fixture.

**Fig. 2. Cast-aluminum gimbal for a missile guidance system requiring 140 holes is center-drilled, drilled, and tapped by tape control in six simple setups.**

Perhaps the most interesting result in this and similar short-run applications is the savings in tooling costs. The automatic positioning of the tape-controlled table eliminates the need for complex jigs and fixtures. Simple work-holding arrangements and standard clamping devices usually suffice. In addition, lead time is short since the tapes can be quickly prepared.

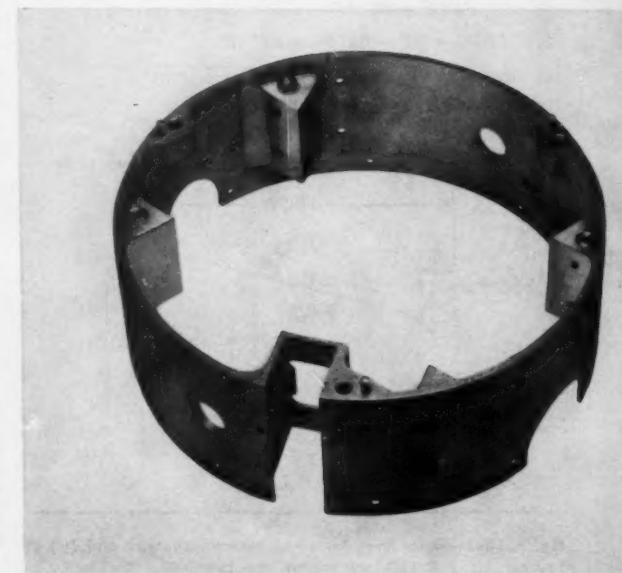
The operator receives the prepared tape and a program sheet which lists the turret tooling and gives the data needed to make machine adjustments. Once the automatic cycle is started, all machine functions are controlled by tape. The table positions the work under the turret within plus or minus 0.001 inch for each operation and the turret automatically indexes through a predetermined sequence. During each turret index, the working spindle and cutting tool shift to the preselected machine settings of speed, feed, and depth of cut.

Other applications of the machine include the center drilling, drilling, and tapping of 140 holes in a cast-aluminum gimbal (Fig. 2) used in a missile guidance system. Although six separate setups are employed, only simple tooling and 2.3 hours of machine time per part are required.

In two setups, twenty-eight holes are machined in the top section (Fig. 3) and bottom of a cast-steel hydraulic control-valve inlet. The holes are center-drilled, drilled, counterbored, chamfered, and tapped in 1.2 hours. Nine holes are machined in the bronze ring shown in Fig. 4. This part—which is used in a missile—is center-drilled, spot-faced, drilled, tapped, and bored in a single setup in forty-two minutes. The tooling employed required only four man-hours to produce. A study of six typical short-run jobs showed that the savings in tooling per job averaged over \$540.

**Fig. 3. Only two setups are required to center-drill, drill, counterbore, chamfer, and tap—as necessary—twenty-eight holes in this top section for the inlet of a hydraulic control valve. Machining time is 1.2 hours.**

**Fig. 4. A typical short-run missile component, this bronze ring has nine holes produced in up to five operations by the tape-controlled turret drilling machine in forty-two minutes. A single setup was used.**





# MACHINERY'S PROBLEM CLINIC

Mathematical problems in shop work and tool design submitted by readers of MACHINERY

Edited by HENRY H. RYFFEL

## Locating Centers for Tangent Arcs

BERNARD PACKER, Shaker Heights, Ohio

In making a punch and die for blanking the part in Fig. 1, it was necessary for the toolmaker to calculate the  $x$  and  $y$  coordinates of the 0.250-inch radius in relation to the center of the 0.180-inch radius. Figure 2 shows the various triangles that were used in the trigonometric solution that follows.

*Solution:*

1.  $CB = .180 \times \sin 15^\circ = .180 \times .25892 = .0466$
2.  $AB = .180 \times \cos 15^\circ = .180 \times .96593 = .1739$
3.  $CB + .180 = .0466 + .180 = .2226$
4.  $DB = .180 - AB = .180 - .1739 = .0061$
5.  $EC = 1.000 - (CB + .180)$   
 $= 1.000 - (.0466 + .180) = .7734$
6.  $EF = 1.500 - DB = 1.500 - .0061 = 1.4939$
7.  $\tan \angle ECF = \frac{EF}{EC} = \frac{1.4939}{.7734} = 1.9316$   
 $\angle ECF = 62^\circ 38'$
8.  $\angle EFC = 90^\circ - 62^\circ 38' = 27^\circ 22'$
9.  $CF = \sqrt{EF^2 + EC^2} = \sqrt{1.4939^2 + .7734^2}$   
 $= \sqrt{2.8298477} = 1.682$

10.  $\angle GFC = \angle EFC - 15^\circ$   
 $= 27^\circ 22' - 15^\circ = 12^\circ 22'$
11.  $\angle GCF = \angle ECF - 15^\circ$   
 $= 62^\circ 38' - 15^\circ = 47^\circ 38'$
12.  $CF = CH + HF$   
 $= GH \cot 47^\circ 38' + GH \cot 12^\circ 22'$
13.  $GH = \frac{CF}{(\cot 47^\circ 38' + \cot 12^\circ 22')}$   
 $= \frac{1.682}{.91206 + 4.5609} = \frac{1.682}{5.473} = .3073$
14.  $CG = GH \times \csc 47^\circ 38'$   
 $= .3073 \times 1.3535 = .4089$
15.  $JG = CG \times \sin 15^\circ$   
 $= .4089 \times .25882 = .1058$
16.  $JC = CG \times \cos 15^\circ$   
 $= .4089 \times .96593 = .395$
17.  $KG = .250 \times \sec 30^\circ$   
 $= .250 \times 1.1547 = .2886$
18.  $GL = KL = .2041$
19.  $AM = (KL + JG) - AB = .136$
20.  $KM = (JC + CB) - GL = .2375$

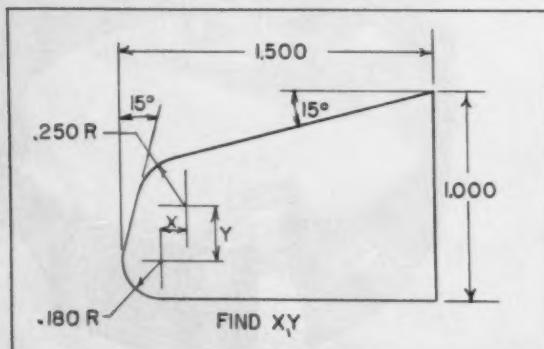


Fig. 1. Sheet-metal form for which coordinates ( $x$ ) and ( $y$ ) of 0.250-inch radius are required.

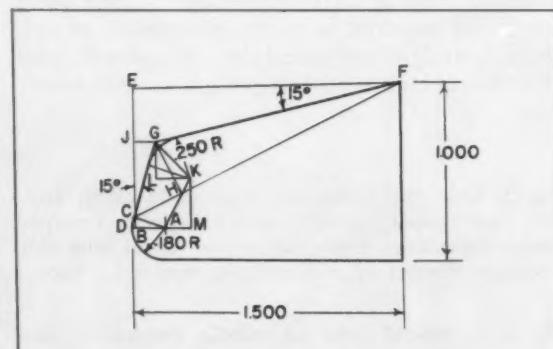


Fig. 2. The triangles shown here are needed in solving for coordinates ( $x$ ) and ( $y$ ) in Fig. 1.

MACHINERY'S

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Reference Section

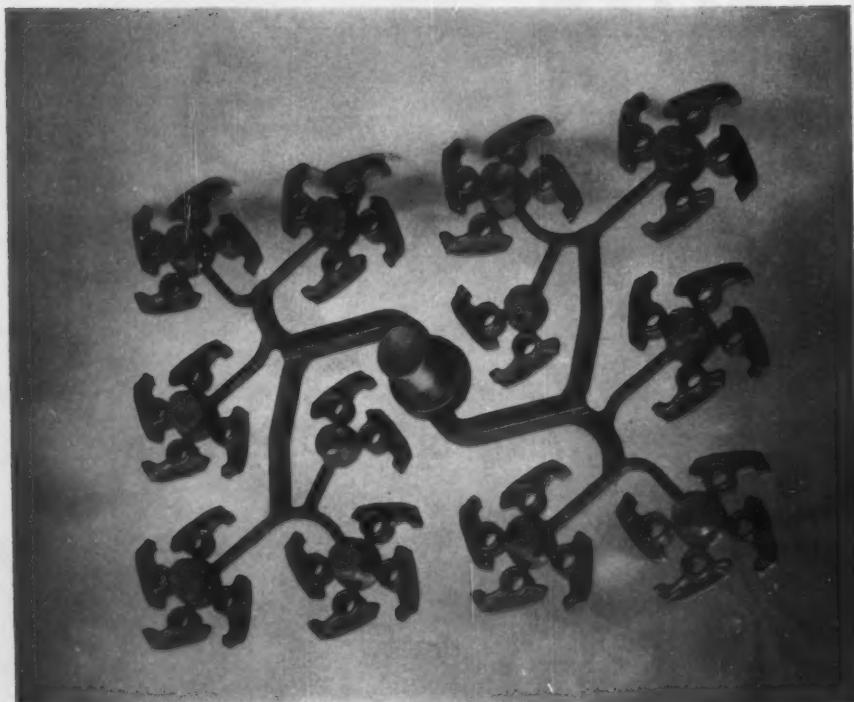
# PEARLITIC MALLEABLE IRON—

## An Engineering Alloy of New Significance

LAURENCE W. COLLINS, Jr.  
Associate Editor

NOVEMBER 1960

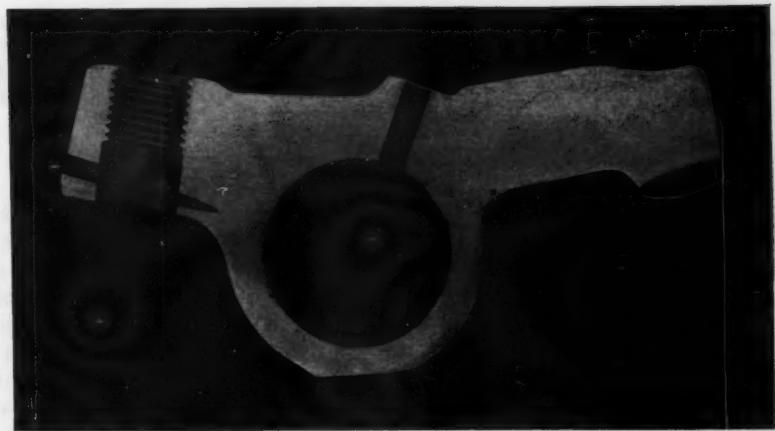
# PEARLITIC MALLEABLE IRON—



## AN ENGINEERING ALLOY OF NEW SIGNIFICANCE

The resurgence of malleable iron as a structural material with wide automotive applications is traced to the desirable content of iron carbide in white iron, the as-molded condition of the castings. This constituent makes the material easy to work in the annealed state. Heat-treatment produces a spheroidized structure having excellent qualities in tensile strength, hardness, and resistance to wear. The ability of pearlitic malleable iron to be selectively hardened adds to its attractive qualities

**Fig. 1.** Macrostructure cross-section of pearlitic malleable rocker arm shows the hardened pad as dark area at right.



BECAUSE PEARLITIC malleable iron is easy to harden selectively, this versatile material is now competitive in a market once reserved to forged-and cast-steel parts.

Gears, sprockets, hubs, and crankshafts are prime applications for this newcomer material. All are moving parts which require machining in the process stage, plus a combination of abrasion resistance and good bearing qualities in service. Since extremely hard metals are usually troublesome to machine, pearlitic malleable offers a unique versatility. In its unhardened (pearlitic) state, it has a machinability rating equal to dead-soft cast iron and many of the free-cutting steels. But hardening will produce parts which attain 50 Rockwell C or higher. Wear qualities compare with those of carburized steel.

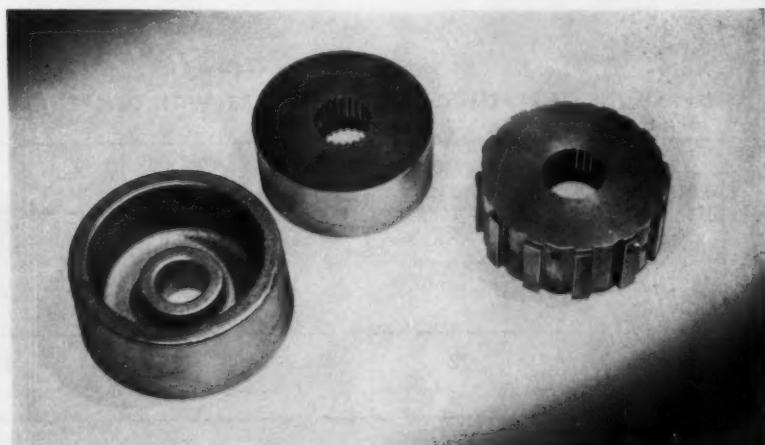
The most useful microconstituent for imparting hardness to ferrous alloys is carbon in the combined form, iron carbide ( $\text{Fe}_3\text{C}$ ). The quantity, form, and distribution of the iron carbide

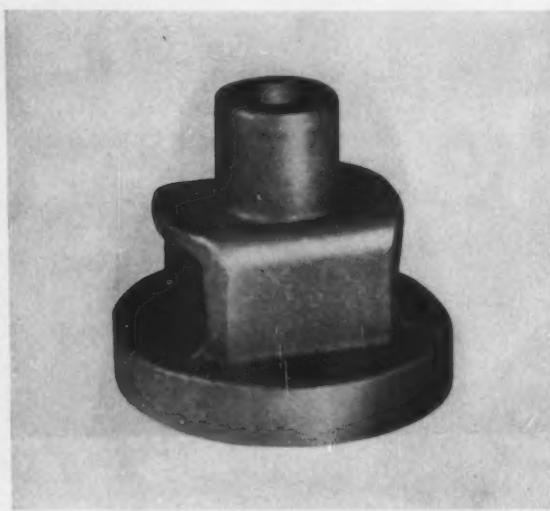
determines the over-all hardness of the finished work-piece. In sharp contrast to the usual ferritic malleable iron (whose matrix is free from combined carbon), pearlitic malleable irons contain 0.30- to 0.90-per-cent carbon in the form of iron carbide. Since this constituent readily goes into solution by a simple heat-treatment, pearlitic malleable castings (heading illustration) are selectively hardened with ease.

The automotive rocker arm, Fig. 1, offers an excellent example of pearlitic malleable's capabilities. The pad faces are hardened for wear resistance, while the body of the part is left soft to withstand alternating shock loads applied from different directions. Originally, all automobile manufacturers used steel rocker arms with the pad end either flame- or salt-bath-immersion-hardened. But the steel parts required a costly brass or bronze bushing for a bearing surface with the rocker-arm shaft.

Influencing the change to pearlitic malleable

**Fig. 2.** Stages in manufacture of pearlitic malleable transmission hub shows the part, as-cast on the left; turned, faced, and bore-splined (center); outside-diameter-splined and hardened, right.





**Fig. 3.** Improved life and better machinability were achieved by converting this automotive hub transmission clutch to pearlitic malleable. Gear teeth are induction heat-treated one at a time.

castings by several auto makers were these factors: Pearlitic malleable parts are easily hardened; they offer ample tensile strength for the application; their superior bearing properties obviate the need for a bushing; and machining costs are less. Pearlitic malleable rocker arms are conveniently heat-treated by either the salt-bath-immersion or the induction method, attaining the desired hardness of 50 Rockwell C to a minimum depth of 0.030 inch.

Somewhat the same list of advantages was responsible for changing an automotive hub transmission clutch (Fig. 2) to pearlitic malleable. Further, the part shares a heat-treating fixture with two others hardened simultaneously. This casting outwears the part it replaced, is lighter in weight, and requires the removal of less metal with greater ease of machining.

Since the hardening treatment of pearlitic malleable irons involves only heating and quench-

ing, any of several common heating methods may be employed—induction, flame, salt- or lead-bath, or conventional atmosphere heat-treating furnaces. Where a shallow depth of case is desired, the induction and flame methods are preferable. If the case depth of hardening is unimportant, any of the procedures can be utilized.

The depth of case is controlled by the rate of heat input. The degree of hardness is regulated by the time and temperature of the hardening treatment, the rate of quenching, and any subsequent tempering treatment.

The quench rate is controlled by the quenching medium, which, in turn, determines the maximum obtainable hardness. Various quench media may be employed, including water, brine, oil, salt or lead bath, aqueous solutions of special proprietary compounds, or air. The response to hardening depends upon such factors as section thickness to be hardened, distribution of the temper carbon, chemical composition of the iron, type and quantity of the combined carbon already in the matrix, and the kind of heating equipment available for the hardening treatment. Selection of a hardening method is always the result of experiments to accommodate varying factors of dimension, end use, and metallurgy of a given part.

General conclusions concerning the surface hardening of pearlitic malleable irons have resulted from studies conducted at the University of Michigan under the sponsorship of the American Foundrymen's Society. For induction hardening, the investigators reported that proper

**Table I**

**COMPARISONS OF PEARLITIC MALLEABLE GEARS WITH COMPETITIVE MATERIAL ON THE SAME JOB**

MATERIAL	HOURS OF TEST	LOAD, POUNDS	COST	REMARKS
Gray iron	10	415	\$1.24	Teeth flake off
Nodular iron	12	415	2.18	Rolling and mushrooming of teeth
Pearlitic Malleable	72	415	1.73	No failures or signs of wear

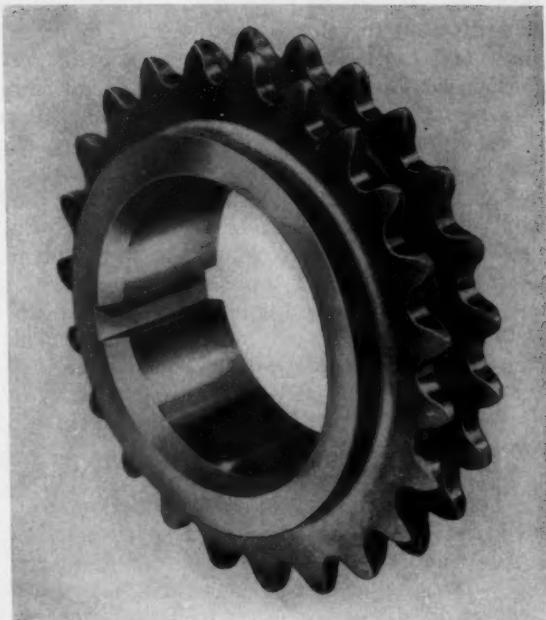
**Fig. 4. Excellent machinability and ease of selectively hardening the teeth were responsible for the choice of pearlitic malleable iron for this crankshaft sprocket.**

time and power input were controlling factors which, when properly selected, give satisfactory results with all the irons tested. Chemical composition, within the limits investigated, showed no noticeable effect on the response of the irons to hardening. A dense pattern of finely spheroidized cementite consistently yielded the highest hardness (50 Rockwell C) to a depth of 0.060 inch over the range of power and time investigated. The over-all result of the tests indicated a material feasible to heat-treat using standard production shop installations.

The experience of a major agricultural equipment maker offers a good case of how one user capitalized on the induction method. Chronic field failures of the driving gear of a small tractor caused him to turn to a pearlitic malleable-cast gear with rugged tooth construction.

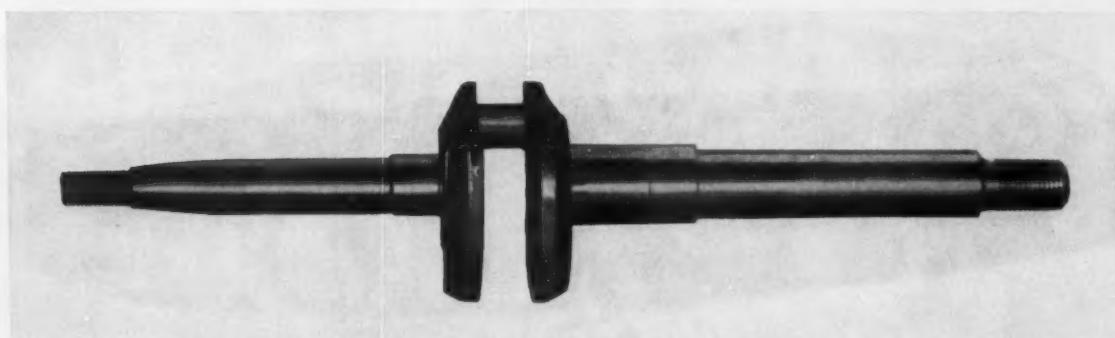
The part is the main drive gear, with a ratio of 108 to 1, on a tractor powered by a 4-hp gasoline engine. In gray iron, the teeth broke down by flaking in severe use. In choosing a replacement, the implement maker considered, among others, pearlitic malleable iron, Grade 60003, induction-hardened to 55 Rockwell C after the teeth were machined.

Sample castings of this type (Fig. 3) were submitted, and the prospective buyer tested them in field-service situations for seventy-two consecutive hours. The parts showed no signs of wear or any indication of failure. The comparative results of three materials tested are shown in the accompanying table. The pearlitic malleable structure was produced in an atmosphere-controlled fur-



nace by the arrested anneal process, and tempered in a convection type draw furnace. Machinability of the part kept costs to a minimum for the resistance to wear and the strength delivered. Furthermore, costs of the castings and processing them were competitive.

For flame hardening, the study proved that: temperature control is critical; an increase in manganese in the chemical composition is accompanied by an increase in hardness and depth of case in irons of similar microstructure; an increase in heating time produces a more uniform and deeper case; and, to secure 50 Rockwell C at a depth of 0.060 inch, a quench in water is necessary. A dense pattern of finely spheroidized



**Fig. 5. Pearlitic malleable crankshaft is hardened by induction heating at two journal bearings and also at the pin in a two-station fixture.**

cementite consistently gave the best results, whereas a microstructure made up chiefly or entirely of coarse spheroids gave the poorest performance. The superior performance of fine microstructure thus is consistent throughout heat-treating practice.

A truck crankshaft sprocket (Fig. 4), formerly hogged out of solid steel bar stock, is now cast from pearlitic malleable. After machining, the teeth of the sprocket are exposed to an acetylene flame for 0.11 minutes, raising the temperature enough to produce a minimum of 55 to 58 Rockwell C, followed by an automatic quench in oil, which is held at a temperature of 90 degrees F. Performance of this part is highly satisfactory in service; material costs are less; and machining costs are significantly reduced.

A pearlitic malleable crankshaft (Fig. 5) made for Tecumseh Products Co., is induction-hardened at three different sections (two journal bearings and the crankpin) in twenty-four seconds, including a station transfer. The equipment used is a General Electric high-frequency, 450-kc 25-KW unit. The two journal diameters, 0.725 and 1.017 inches, respectively, are heated on one station and are hardened simultaneously. The total operating time in the first station is fourteen seconds—nine seconds at heating; three seconds at water quench; and the remaining two seconds are consumed in the transfer to the adjoining pin-heating station.

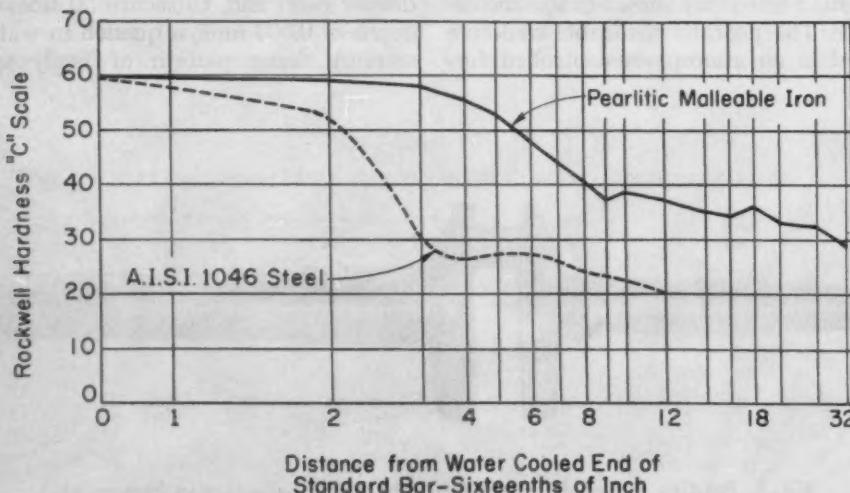
The diameter of the pin is 0.767 inch. Its total heating cycle is ten seconds, of which seven and

one-half seconds are in heating, and two and one-half seconds in the water quench. The approximate temperature is 1600 degrees F. No difficulty is encountered in attaining the specified hardness, 54 to 58 Rockwell C. The maximum case depth is, roughly, 3/16 inch. The macrograph of a longitudinal cut on the selectively hardened areas has a pattern resembling a semiellipse, with the minor axis at maximum case depth and the major axis tapering outward along the shaft. The length of the case pattern is necessarily governed by the length covered by the coil fixture. Fixture design is the same as for other ferrous heating.

Both selective and through hardening are accomplished satisfactorily by immersion of pearlitic malleables in a lead or salt bath at temperatures of 1450 to 1700 degrees F. The temperature will depend upon the type of pearlitic malleable iron, the subsequent quench rate, and the intricacy of the casting. A hardness of 50 Rockwell C minimum has been attained by immersing sections of 1 inch or less having a 163 to 207 Brinell hardness, for approximately five minutes, followed by an oil quench.

The hardenability curve of pearlitic malleable, Fig. 6, shows the results obtained in tests on standard end-quenched specimens as compared to results with forged AISI 1046 steel. In another study it was proved that hardenability curves were similar regardless of the quenching method, and that pearlitic malleable iron has end-quench hardenability similar to that of AISI 1340, AISI 4045, and similar steels.

Table II. COMPARISON OF HARDENABILITY CURVES CONTRAST PEARLITIC MALLEABLE IRON WITH FORGED AISI STEEL



# MODERN MACHINE TOOLS

## Break Bottleneck in Bottlemaking

The biggest element of cost in the making of glass containers is the molds. These vital parts wear rapidly. Dimensional tolerances in the bottle industry are being tightened to meet fierce competition from paper and tin plate. Recently the costs of moldmaking operations have been trimmed by new machine tools and methods

LAURENCE W. COLLINS, Jr., Associate Editor

The glass-container industry is growing rapidly. More glass bottles and jars are being used in an ever increasing variety. In 1959 19.7 billion new glass containers went into commerce—about 116 units for every man, woman, and child in the country's population. Companies that package commodities in glass containers are specifying fluid capacities as close as 1/32 of an ounce. That means stiffer tolerances for glass moldmakers to meet.

The glass-container industry is fighting constantly to drive costs down to meet competition from paper, tin cans, and plastic. Obviously the logical target for economy in the glass industry is to reduce the cost of molds per unit of production. The molten glass from which bottles and jars are made represents the least cost, which is the exact opposite of the cost situation in paper and tin-plate containers. For example, the complete "tooling" for a six-station glass-bottle molding machine such as seen in Figs. 9, 10, and 11, costs about \$5000, and has a number of highly perishable parts that must be replaced frequently because molten glass scores them.

Part of the cost-cutting campaign in the glass-container industry has taken the form of an equipment-modernization program for moldmaking facilities, and methods studies designed to lengthen the life of molds. Several moldmakers have successfully reduced the floor-to-floor time of making mold components through the introduction of two types of machines: the single-spindle automatic chucking lathe and a new hand turret lathe, both built by Warner & Swasey Co. of Cleveland, Ohio. These replacements for

traditional engine-lathe equipment have brought in with them interesting tooling that gives greater speed, tighter dimensional control, and longer mold life. The new methods include:

1. The use of wrap-around chuck jaws in the "chuckers," and large-bore drawback collets for

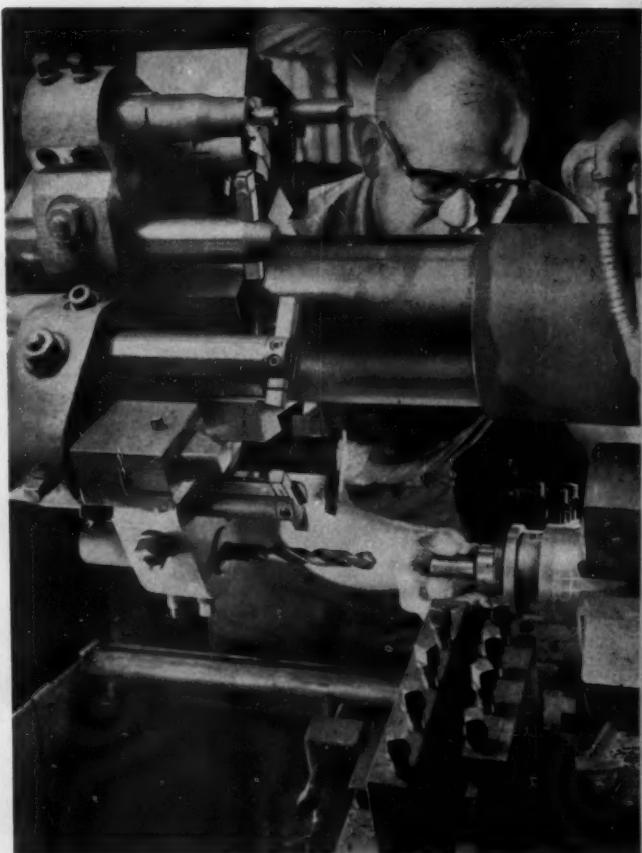


Fig. 1. Neck rings for glass molds are turned by a Warner & Swasey 1AC chucker at Toledo Mold Co.

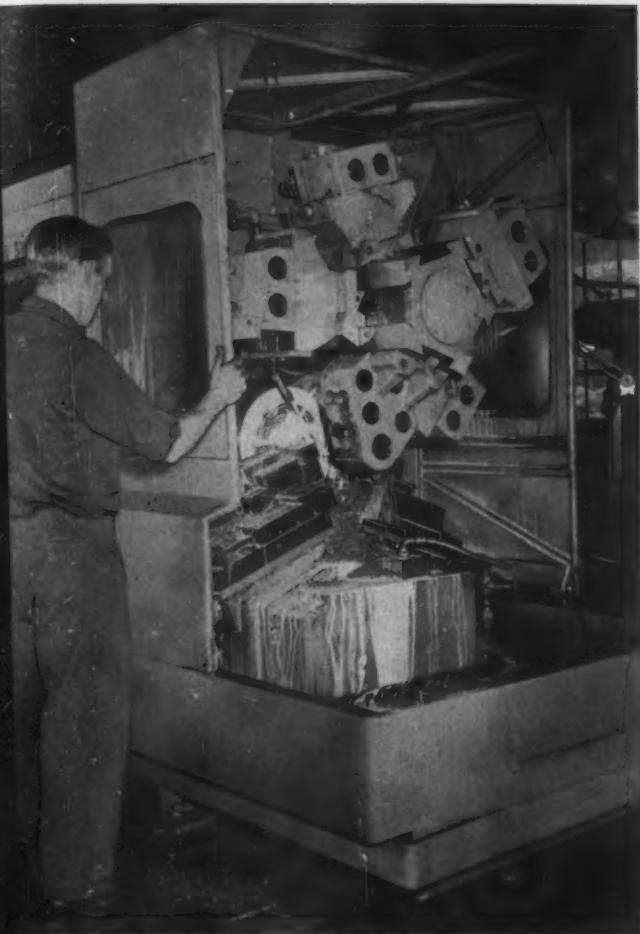


Fig. 2. Double-length blanks make two bottle-mold neck-ring die pairs on a W&S 3AC automatic at Metro Glass Division, National Dairy Products.

turret lathes that distribute gripping pressures evenly and thus eliminate distortion of the work.

2. The machining of parts from double-length slugs, so that one end acts as a chucking holder while the other end is being machined. The result is two pairs of parts—both free of distortion.

3. The use of multiple cross-slide forming to total tolerances of 0.001 inch.

4. The use of a "late" cross-slide function in the automatic chucking lathes to do internal forming easily.

5. The use of a hydraulic tracer on a turret lathe for contouring parts having special wear-resistant coatings. Negative-rake, throw-away carbide bits are used.

6. The cutting of internal contours up to 2 1/2 inches in diameter and 7 1/2 inches deep, that are drilled and finish-formed by reamers. The application of hard-surface coatings by spraying over cast iron for increased wear resistance and longer life.

Glass-mold neck rings are being turned in Fig. 1 by a 1AC single-spindle automatic chucking machine at the Toledo Mold Co. The wrap-around chuck distributes the gripping pressures on the work evenly, eliminating distortion of the work-piece. Multiple cross-slide forming holds tolerances to 0.001 inch.

Double-length blanks are used at the Metro



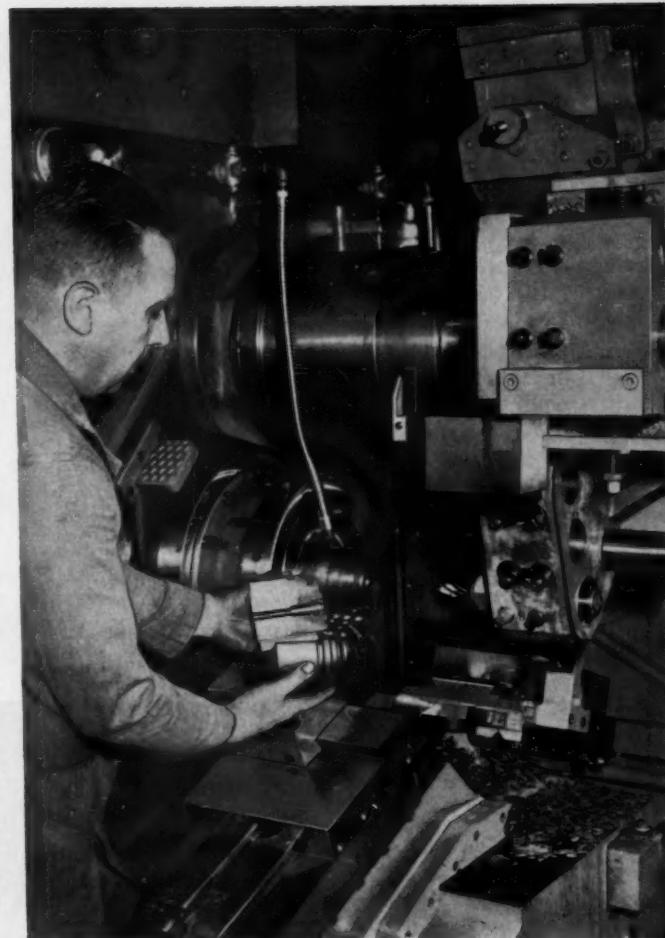
Fig. 3. Turret lathe operations have resulted in substantial mold-production increases at Toledo Mold Co.

**Fig. 4.** A late cross-slide operation on a W&S Model 3AC machine turns internal profile of a bottle-neck mold. The two slugged halves are machined together.

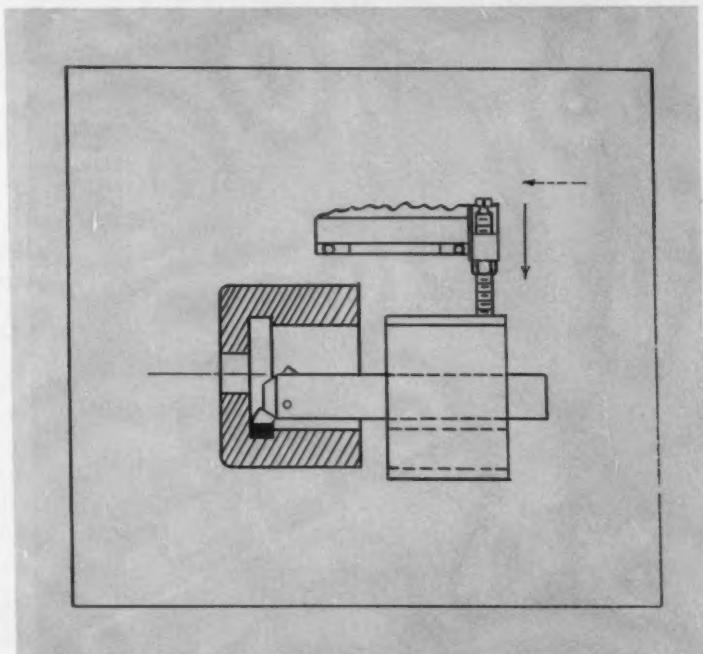
Glass Division of National Dairy Products in the operation on glass-mold neck rings shown in Fig. 2. The cast-iron "stick" is held by one end and goes through a series of boring, turning, facing, and forming operations on a 3AC single-spindle automatic chucking machine. When the first end has been completed the part is reversed end for end in the collet and the opposite end is machined. A cutoff operation results in two die parts at the end of the cycle.

Production increases of 50 per cent over older machining methods resulted from the substitution of the No. 5 Warner & Swasey ram type turret lathe in Fig. 3 for a former method. A special large-diameter collet chuck holds split bottle molds for facing and boring the neck end. This is another operation at the Toledo Mold Co.

Neck rings for molding beer and soft-drink bottles wear out rapidly in use; therefore this part of the mold assembly must be changed most often. At the Toledo Mold Co. the Model 3AC single-spindle chucking automatic in Fig. 4 uses multiple cross-slide forming on outside diameter cuts and also forms the internal bottle-neck contour with a standard late cross-slide operation. To do this the turret rapid-traverses to the end of its stroke and dwells there while the cross-slide feeds, pushing a slide tool on the turret forming the internal contour.



**Fig. 5.** Schematic diagram of a late cross-slide chucker station. Form tools are substituted for the straight plunge-cutting tool shown.



How the late cross-slide operation forms the internal bottle-neck contour in neck rings is shown schematically in Fig. 5. Other machine functions which can be used with the late cross-slide operation are: change of speed and feed during a cut, and reversal of feed or stoppage of spindle on turret return for elimination of tool withdrawal marks.

A hydraulic cross-slide tracer on the Warner & Swasey No. 5 turret lathe in Fig. 6 takes the finish cut on a glass-mold plunger. This operation at Hazel-Atlas Glass Division, Continental Can Co., follows hard coating of the part with Metco or Colmonoy having a hardness of 35 to 40 Rockwell C. The same machine previously rough-traces the plunger form.

Internal contours, from 7/8 inch to 2 1/2 inches in diameter and up to 7 1/2 inches deep, are progressively drilled (four different diameter drills used) and finish-taper-reamed on the Model 2-A saddle type turret lathe illustrated in Fig. 7. The parts are press and blow plungers for molds made by the Thatcher Glass Mfg. Co., Inc. Addi-

tional operations done in the setup include end facing, outside diameter turning, grooving and chamfering, as well as thread chasing.

"Hot-flowing" of sprayed-on coating is the third and final step in the hard facing of glass-mold plungers. This operation is shown in Fig. 8. After tracer machining on the turret lathe, the plungers are sandblasted, then sprayed-coated, and finally the coating is fused on with an acetylene torch. Mold shops such as that at Metro Glass are doing this processing of plungers to get longer life and are using either Metco or Colmonoy coatings sprayed to a depth of about 0.020 inch. Finish contouring of the hard-coated plungers (Rockwell C 35 to 40) is done at 300 surface feet per minute, 0.005 inch feed and 0.010 inch depth of cut, using a negative rake, clamp-on cutter holder and carbide cutter.

Typical cast-iron bottle-mold parts turned on Warner & Swasey 1AC and 3AC single-spindle, automatic chucking machines at Toledo Mold Co., are shown in Fig. 9. These mold components are identified as follows: neck-ring half A, sleeve

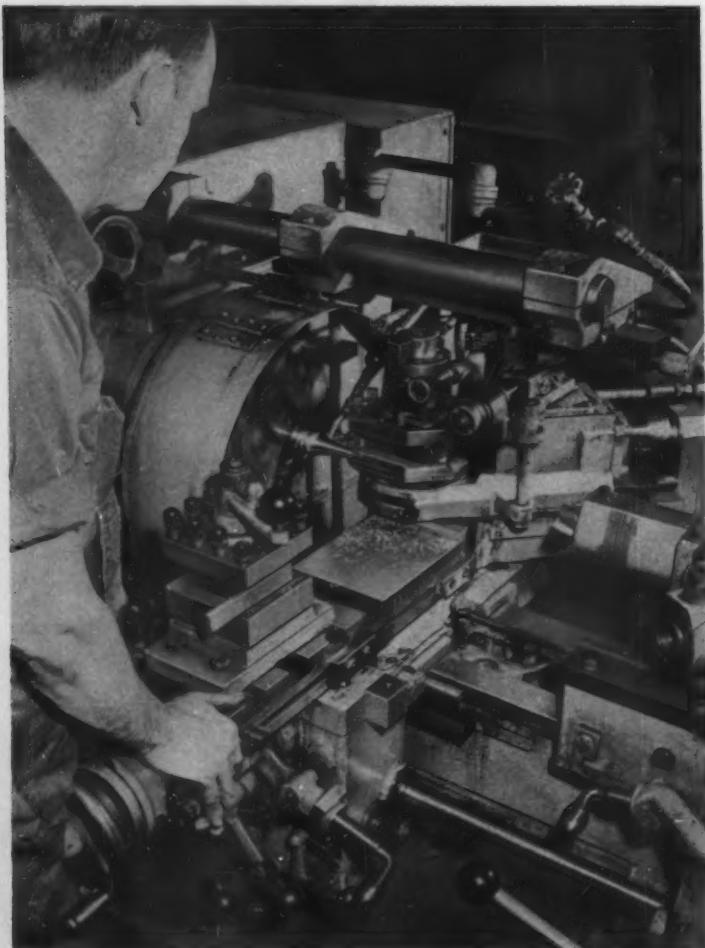


Fig. 6. Hydraulic cross-slide tracer on a W&S No. 5 turret lathe takes a finish contour cut on a hard-faced glass-mold plunger.

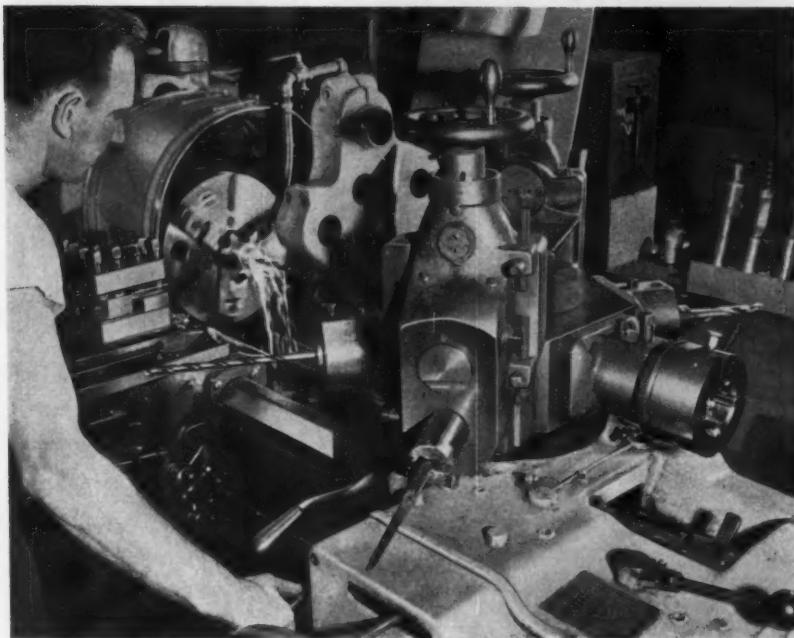


Fig. 7. Internal contours up to 7 1/2 inches in depth are drilled in mold plungers on a No. 2-A saddle type W&S turret lathe at the tool room of the Thatcher Glass Mfg. Co.

B, bottom plate C, funnel D, baffle E, plunger F and blow head G. Of these, the neck rings and plungers wear the most rapidly.

"Slugging" is a machining technique commonly used in mold shops for producing bottle-mold neck rings. Semicircular slugs, A, Fig. 10, twice the length for a single neck ring, are held for turning in either large collet chucks or with wrap-around chuck jaws on single-spindle chucking automatics. After one end of the pair has been turned as at A, the opposite end of the assembly is machined as at B in the second operation. Finally, internal contouring and a center cutoff produces the individual pairs of completed neck rings C.

Development of a mold for the "pop" bottle A, Fig. 11, from a gob of molten glass follows a cycle pattern using the mold tooling shown. The "blank" mold is seen at B. When the two halves are assembled in the machine, plunger D and neck ring E are beneath funnel C. The hot glass is poured through the funnel. Baffle F automatically replaces the funnel and compressed air forces the ductile glass to conform to the shape of the blank mold cavity. The blank mold then opens and the rough-formed bottle is automatically inverted and transferred to the open finish mold H. In the transfer, the molten gob of glass

is held by the neck ring. Blow head K next comes down over the neck so that the entry of compressed air through the blow head and into the neck of the bottle inflates the glass to fill the cavity until it presses against bottom plate J. The take-out tongs G lift the finished bottle from the mold and transfer it to a conveyor which takes it into the tempering oven.

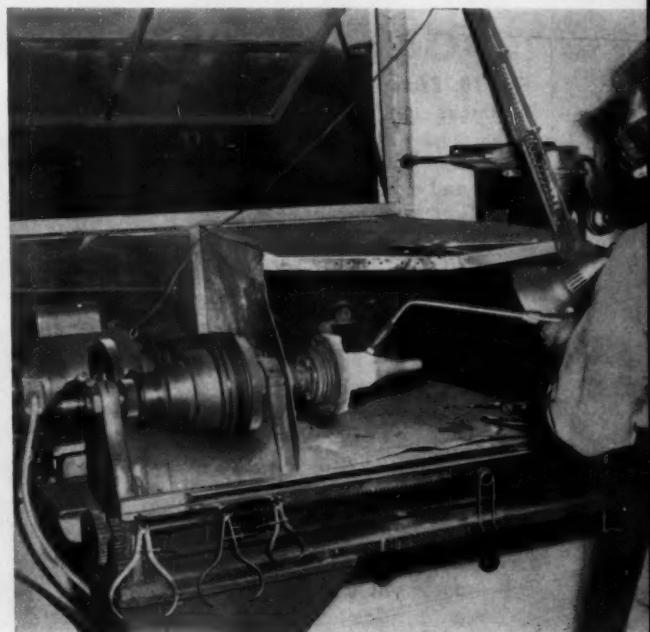


Fig. 8. Hot flowing the sprayed-on, hard-faced coating of a glass-mold plunger at Metro Glass Division.

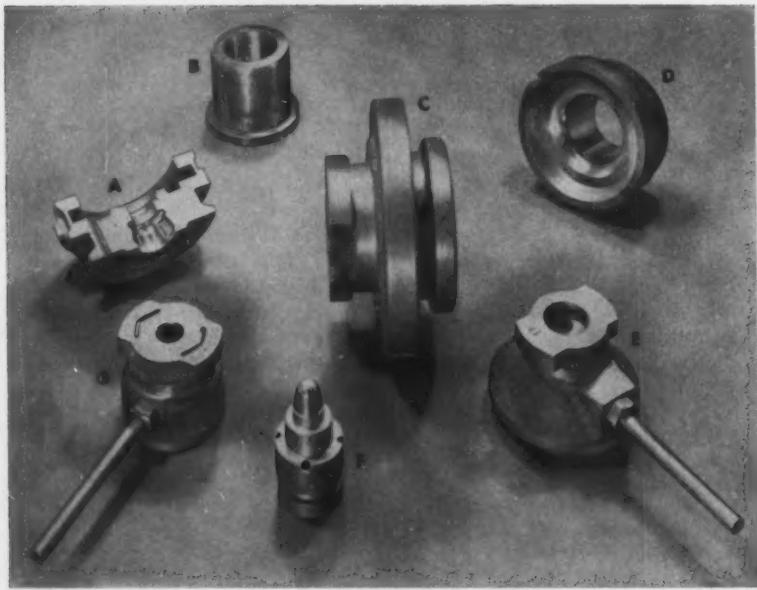


Fig. 9. Glass-mold components turned on W&S chuckers. Of these, the neck rings (A) and the plungers (F) wear out the most rapidly in use.

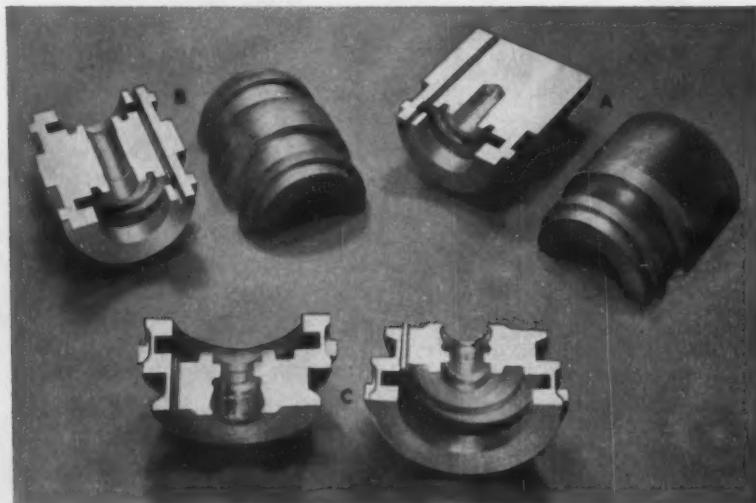


Fig. 10. Examples of the slugging technique used in making glass-mold neck rings. Double-length slug pair (A) is reversed in the chuck and machined as at (B), and sliced into pairs as at (C).

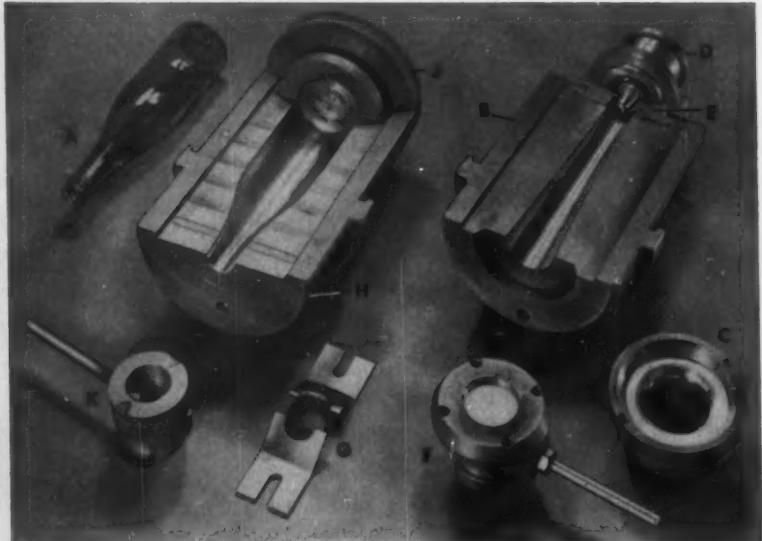


Fig. 11. Lower-cost glass-mold tooling for a "pop" bottle (A) requires the mold halves shown assembled from components made on modern turned on W&S chuckers. Of these, turret lathes and single-spindle automatic chuckers.



## MAGNETIC POSITIONING MEMORY Programs Swiss Jig Borer

THE HYDROPTIC-6A, a Swiss-made jig-boring and milling machine with the DIR memory device, Fig. 1, combines the power and precision to produce high-quality work while cutting production time at the Timken Roller Bearing Co.'s Columbus, Ohio, plant. Forty machine positions can be dialed and automatically repeated to an accuracy within 0.00002 inch, using a program stored in the machine's magnetic memory. On a single piece having a series of holes to be drilled, the operator positions the machine's table for the first center drilling of each hole. The memory device records the specific table-positioning information, eliminating the necessity for succeeding optical measurements. After drilling, the operator can bore for close tolerance, again without optical measurements.

Without this memory unit, the operator would

be required to perform three separate locating operations (Fig. 3) for each hole before moving to the next one. With the new memory device, all center drilling on all holes is done before performing the regular operation. The ultimate result is a substantial time-saving factor. Saving in over-all production time by using the DIR device (console controls and memory drums) varies between 8 and 20 per cent, according to the type and number of pieces to be machined. Timken manufacturing engineers feel that the unit will reduce positioning-measuring time by nearly 50 per cent. Once motions are recorded, the operator no longer has to depend on slow optical measurements (heading illustration). Measurements are recorded on the magnetic drum during the first operation, if the job is to be repeated. Thereafter it is only a matter of



Fig. 1. (Above) Graduate of Timken Roller Bearing Co.'s Columbus Toolmaker School dials coordinate positions into DIR console for programming jig borer.

pushing a button to reproduce the same work-piece hole layout. Thus, there is an added advantage when repetitive jobs are recorded on magnetic drums and filed for future use. A typical example of a programming table which indicates the recorded coordinate positions to be performed by the machine is shown in Fig. 2.

Two of these machines are used at the Timken tool department, Canton, Ohio, but these are not equipped with the memory device. With or without the DIR memories, the Columbus and Canton machines offer other outstanding features, including an optical precision measuring system and a Rotoptic table for dividing circular work into angular segments with indexing to within 1 second of an arc. The machine does a wide variety of work at extremely close tolerances. For example, machine tool-slides are now machined to blueprint size on these machines, reducing scraping time as much as 90 per cent. The diamond quill slide for the dresser on a No. 1 Cincinnati cylindrical grinder was machined in an hour and a half at the company's Canton plant. This eliminated sixteen hours of scraping.

Fig. 2. Manuscript of the machine commands which are programmed into the memory-drum device of the Hydroptic-DIR machine for making a blanker die shoe.

SOCIETE GENEVOISE D'INSTRUMENTS DE PHYSIQUE GENEVA - SWITZERLAND									
No	SPINDLE HEAD		TABLE		RPM	FEED	TOOL	DIA	OBSERVATIONS
	Ref	Co-ordinates	Ref	Co-ordinates					
1	1	20,000	1	20,000					CENTER OF SHOE
2	2	25,500	2	22,500	400	0.006	DRILL	21/12	*
3	3	11,500	3	17,500	*	*	*	*	*
4	4	25,500	3	17,500	*	*	*	*	*
5	5	16,500	2	22,500	*	*	*	*	*
6	6	22,500	4	25,000	500	0.006	DRILL	33/46	*
7	7	17,500	5	11,500	*	*	*	*	*
8	8	17,500	6	25,000	*	*	*	*	*
9	9	22,500	5	11,500	*	*	*	*	*
10	6	21,250	6	29,500	500	0.010	131	2.000 MM DRILL PTH HOLE +.0005	
11	6	21,250	7	11,500	*	*	*	*	*
12	1	20,000	1	20,000	625	0.010	112	2.000 MM BORE *.0008	
13	6	21,250			160	1"	FACE MILL	6"	FACE BORE TO 1"
14	1	20,000			500	1/8"	END MILL	5/8"	S/8 EXTRUDE CENTER OF BASE
15									
16									
17									
18									
19									

**Fig. 3. (Right) Jig boring and facing of a large hole through a special die shoe with automatic-controlled Hydroptic-6A.**

Operating in temperature-controlled rooms at the Canton and Columbus plants, the machines handle many difficult milling, drilling, boring, and facing operations. A particular advantage is that the operator can, at all times, control the position of the table and spindle-head saddle to within an accuracy of 0.000002 inch by observing index marks on the auxiliary scales, the micrometer dials, and the projection screens. Operators of these machines are skilled machinists, graduates of the Timken Co. Apprentice Training Program. They have been taught not only to work to close tolerances but also have been trained in complex machining techniques.



## **Armed Forces Offers Course in Economics of National Security**

The Industrial College of the Armed Forces again invites qualified civilians in business, industry, and the professions to enroll in its graduate-level correspondence course entitled, "The Economics of National Security."

Operating under the direction of the Joint Chiefs of Staff, the Industrial College is unique among the military colleges of the world in that it conducts courses of study in the economic and industrial aspects of national security under all conditions and in the context of both national and world affairs. These courses give due consideration to the interrelated military, logistical, administrative, scientific, technological, political, and social factors affecting national security.

As a ten-month resident course, it is conducted by the college at Fort Lesley J. McNair, Washington, D. C., for senior military officers and civilian executives of the Federal Government. It is designed to enhance their preparation for important command, staff, and policy-making positions in the national and international security structure. Through the correspondence course the facilities and program of the college

are extended to those who are unable to receive resident instruction. Today, some 3200 correspondence students are participating, including officers of all components of the Department of Defense; civilian executives and professionals in government as well as in business life; and nationals from several friendly foreign countries.

All texts and instructional materials are furnished at no cost to students. It generally takes about one year to complete all units, after which certificates of completion are issued to satisfactory students. Qualified persons interested in taking the course are urged to apply to the Commandant, Industrial College of the Armed Forces, Washington 25, D. C., Attention: Correspondence Course Division.

Daily attendance figures added up to a total of over 200,000 for the Machine Tool Exposition which had a ten-day "run" during September at the International Amphitheatre in Chicago. This attendance, largely of top metalworking executives, plant managers, and machinery distributors, established an impressive total for such industrial shows. More than 1000 machines were on exhibit, some of them weighing 50 to 75 tons. The total weight of all machine tools displayed was 7250 tons; their value was well over \$25,000,000.

# LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

## Cincinnati Grinding, Profiling, and Milling Machines

The first numerically controlled center type cylindrical grinding machine, Fig. 1, was introduced by Cincinnati Milling's Grinding Machine Division at the recent Machine Tool Exposition. The machine exhibited has a capacity of 18 by 72 inches.

Control of the equipment is by means of the company's Acramatic two-axis system. Sequence and type of operation to be performed, table reversal points, table and wheel-head movements, truing of the grinding wheel, and cycle stops are all numerically controlled. Electrohydraulic servo units provide precise movements of the wheel-head and table.

The possibility of taper because of thermal distortion is eliminated, since hydraulic and coolant reser-

voirs have been isolated from the machine bed. In addition, the center line of the headstock spindle is directly over the center line of the table V-way. A 2-hp motor drives the headstock, and a 20-hp motor drives the grinding wheel. Balancing of the wheel is automatic and is performed in a few seconds.

For occasional jobs which do not justify the preparation of a tape, the desired diameter can be preselected manually; the operator then presses the cycle-start button and the diameter is automatically ground to size. The machine can also be used for traverse or automatic infeed grinding, completely independent of tape control.

In Fig. 2 is a 36- by 120-inch

numerically controlled bridge type profile- and contour-milling machine being introduced by the company's Special Machine Division. It is designed for the automatic production of medium- to large-size parts of complex shape, and for a variety of die-sinking operations. A 20-hp spindle provides twenty-four speeds, ranging from 30 to 3000 rpm. Feeds are actuated by hydraulic motors; the cross and vertical feeds are set up through ball-bearing lead-screws; and the table feed, by rack and pinion, has an antibacklash drive box. By locating the table-driving pinion closely under the cutter, compressive effects are minimized.

Numerical control is provided by an Acramatic three-axis contouring system. Data input is by a perforated tape prepared on a standard Flexowriter. Parabolic interpolation, a feature of the system, fits a parabola to the desired curve, instead of trying to approximate a curve by a large number of straight lines. This greatly reduces the number of calculations and the amount of input data which must be processed. As a result, it is feasible to use a desk calculator if a general-purpose computer is not available. An auxiliary coding of acceleration and deceleration permits smooth starts and stops on either straight lines or curves.

Zero shift of 9.999 inches in each axis is selected by calibrated ten-position switches. An override control allows the operator to adjust the feed rate to suit cutting conditions without having to change the program. An especially useful feature of the Acramatic control is a cutter-diameter compensation, permitting the use of resharpened cutters, or cutters

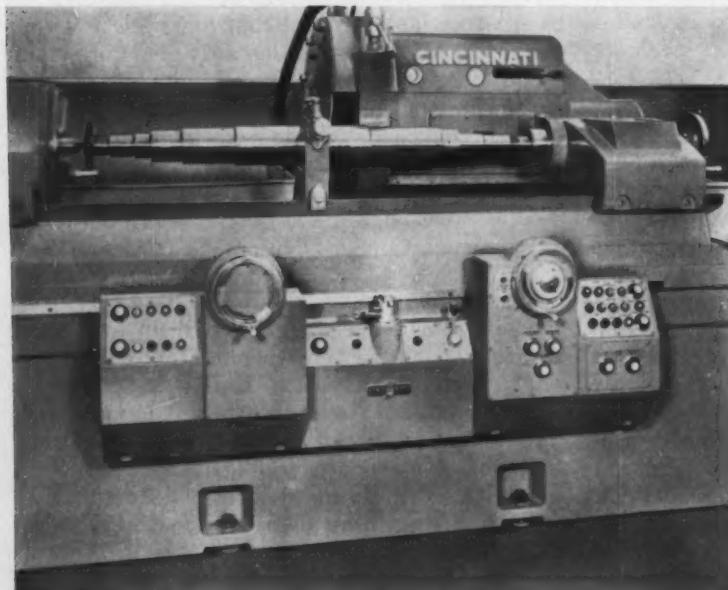


Fig. 1. Cincinnati Milling first numerically controlled center type cylindrical grinding machine

IN

# SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

of different diameters, without having to make an entirely new tape program.

A direct alignment system uses two directional error lights for each axis. The operator turns the handwheel in the direction the lights indicate, and when both lights go out, that axis is properly aligned. Available as an extra is a mirror image which permits right-and left-hand configuration to be made from the same program.

The Milling Machine Division announces the 100 series Powermatics, built in plain automatic and plain rise-and-fall styles. One of the rise-and-fall machines appears in Fig. 3. All machines are of 7 1/2 hp, have a 12-inch-wide table, and have either 24 or 30 inches of table travel.

The machines without rise-and-fall are equipped for automatic table cycles and are arranged with a single start lever for ease of operation. Rise-and-fall machines utilize a hydraulic cycle-selector unit for automatic table and spindle carrier cycles. Cam cycle selectors can be changed in a minute or less, and cycle selectors provide almost any conceivable combination of automatic table and carrier movements. A self-adjusting backlash eliminator for climb milling compensates for wear between the table lead-screw and nut.

Vertical feed of the rise-and-fall spindle carrier is infinitely variable from 1 to 40 ipm. The carrier has 11 inches of vertical adjustment. Table rapid traverse is 300 ipm. There are sixteen spindle speeds, from 50 to 2000 rpm. Table feed, from 1 to 40 ipm, is powered by a 1 1/2-hp motor.

Circle 565 on Readers' Service Card

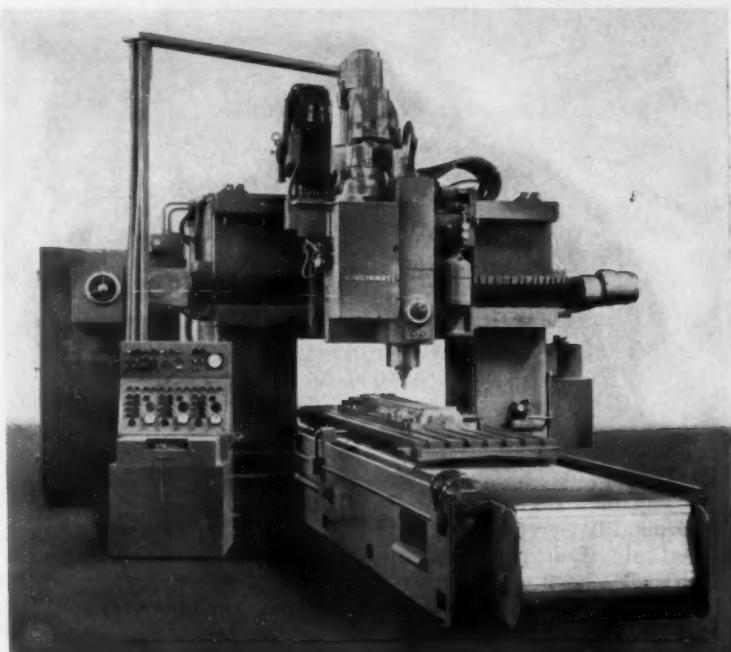
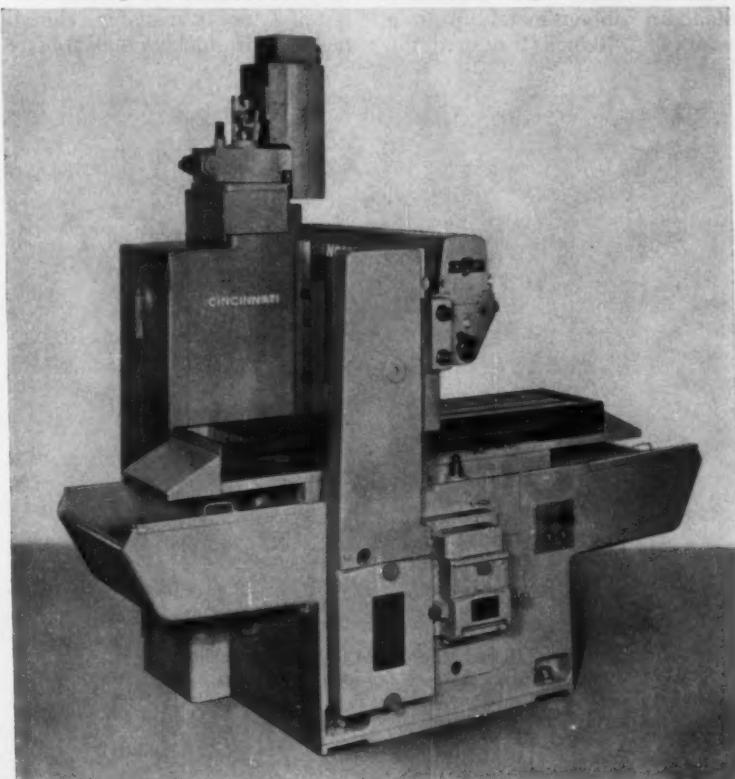


Fig. 2. Profile- and contour-milling machine with Acramatic control

Fig. 3. 100 series Powermatic rise-and-fall milling machine



## Baird Machine Co. Announces Developments in Ribbon- and Wire-Forming Machines

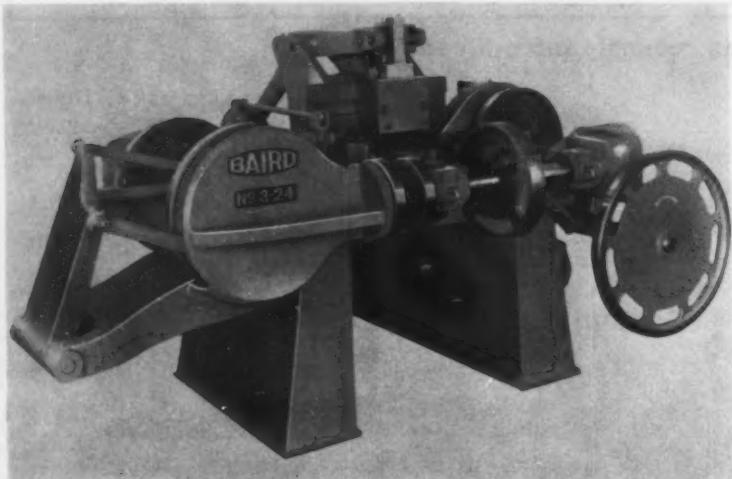


Fig. 1. Baird RWI No. 00 ribbon- and wire-forming machine inclined at a 45-degree angle

A Model RWI No. 00 inclinable ribbon- and wire-forming machine, capable of operating from a horizontal 0-degree position to a vertical 90-degree position (Fig. 1), has been developed by Baird Machine Co., Stratford, Conn. Its hinged bed provides accessibility for tooling and adjustment and maintenance. The machine will accept up to 1/32-inch-diameter soft steel wire and standard ribbon metal up to a width of 3/16 inch. If desired, the

machine can be ordered to handle ribbon metal up to 7/16 inch in width.

On regular work, the operating speed is 350 pieces per minute. With a variable-speed motor, the operating speed range is 134 to 400 pieces per minute. Provision is made for feed length up to 4 1/4 inches with ample tooling areas at each position. A horizontal press attachment, having a rating of 1 ton, is available. The attachment is quickly removable for

tooling at the bench and extends the machine's capability to handle work often associated with larger equipment.

A new flat-face form bracket has been incorporated on the Model 3-24 four-slide ribbon- and wire-forming machine. Fig. 2. It permits the extensive use of simple, inexpensive tooling. Two vertical motions with four strokes are now available, and the vertical motions can be at either end of the tool area. The bracket mounting surface readily permits the addition of special motion units in the tooling area. More open space is also provided in the tooling area both in the horizontal and vertical planes. This clearance, particularly in the vertical dimension, permits the Model 3-24 to accept wider ribbon metal.

Circle 566 on Readers' Service Card

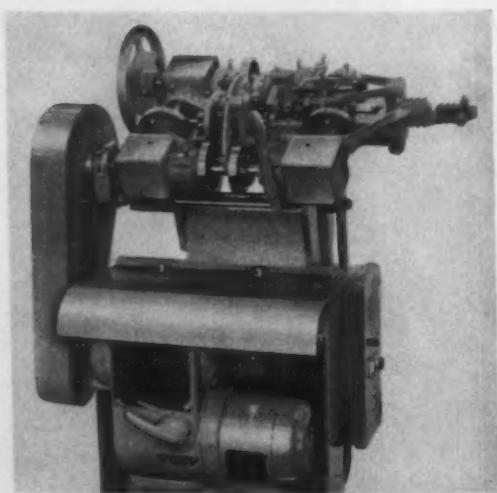


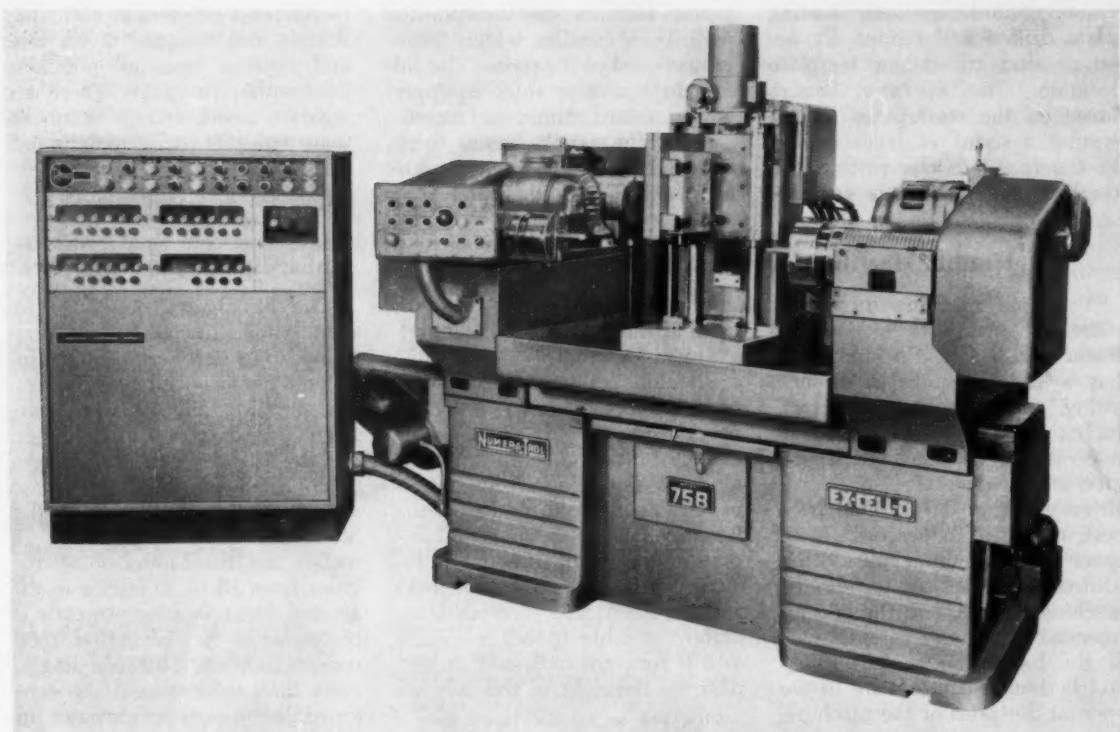
Fig. 2. Baird Model 3-24 four-slide machine incorporating new flat-face form bracket.

## Tape Controlled Machine Automatically Selects Bore Size and Locates Work

The precision boring of several holes of various diameters and in selected locations is performed automatically and in sequence on a new Numera-Trol machine introduced by the Ex-Cell-O Corporation, Detroit, Mich., at the recent Machine Tool Exposition in Chicago. Using a new concept of tape control, this machine not only positions the work in relation to the boring tool, but also adjusts the boring tool to the required hole diameter while the spindle is operating. Thus, single-point boring operations with infinite center locations and variable bore diameters within the limits of the machine are possible.

Accuracy of hole diameter is held within 0.0005 inch; center locations are held within 0.0002 inch of true position; and boring depth is held within plus or minus 0.0005 inch. An incremental tape-positioning system provides control in all axes to increments of 0.0001 inch.

A special tool-control mechanism developed by Ex-Cell-O accepts numerical commands to control the radius of tool rotation.



Precision boring machine with tape control introduced by the Ex-Cell-O Corporation

The device positions the boring-bar to change boring size without stopping the spindle. Programming of infinite boring diameters is possible within a 1-inch range. The boring-bar insert used determines the actual size range; a number of sizes are available.

In this application, straight and

step-boring and counterboring operations are performed from either end of the machine. Boring is programmed to progress in sequence from the largest to the smallest diameter at each end. This eliminates tool drawback lines by adjusting the boring-bar for the next smaller-size hole at

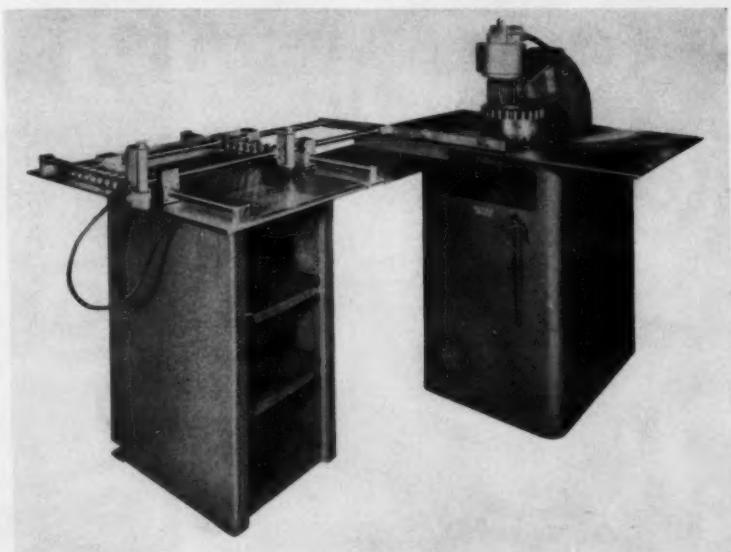
the completion of each stroke. Holes are bored from both ends on the same center line to hold concentricity within very close tolerances. Step-boring operations demonstrate the ability to change diameter by tape-controlled programming.

**Circle 567 on Readers' Service Card**

### Rotex Duplicating Turret Punch Press

A duplicating turret punch press is the newest addition to the Rotex line of metalworking equipment made by the Rotex Punch Co., San Leandro, Calif. Designed for cost cutting, this equipment combines a modified Model 18-AH or 18-BH power-operated turret punch press with a precision duplicating table. It enables operators to economically punch short- and medium-run production work, or handle panel, chassis, and other light-metal fabrication jobs rapidly, accurately, and at low cost.

The duplicator handles tem- plates up to 24 1/2 by 18 1/2 inches. The duplicating table top



Duplicating turret punch press added to line built by Rotex Punch Co.

is a ground-aluminum tooling plate drilled and tapped for accurate and convenient template location. The operator locates holes on the work-piece by inserting a stylus in holes drilled in the template clamped to the duplicator table. Stylus and ac-

tuator buttons are incorporated in gripper handles which insure easy control of the stylus. The Rotex duplicator is fully equipped with standard clamps and stops.

With the quick-change turret feature common to all Rotex turret punch presses, the duplicating

punch press becomes an extremely flexible tool designed to cut time and expense from all punching jobs within its range. There are eighteen punch-and-die combinations with this semiautomatic machine.

Circle 568 on Readers' Service Card

### Honing Machine for Small-Diameter Bores

A honing machine for small-diameter bores developed by Barnes Drill Co., Rockford, Ill., has a 12-inch stroke, a 12-inch swing, and hones bores up to 2 inches in diameter at the maximum stroke. The Plugmatic sizing mechanism maintains size consistency within 0.0002 inch from bore to bore. To keep the floor space to a minimum, all electric controls are enclosed inside the machine column, and the coolant reservoir is made an integral part of the base. The coolant pump and hydraulic controls are in the open at the sides of the machine,

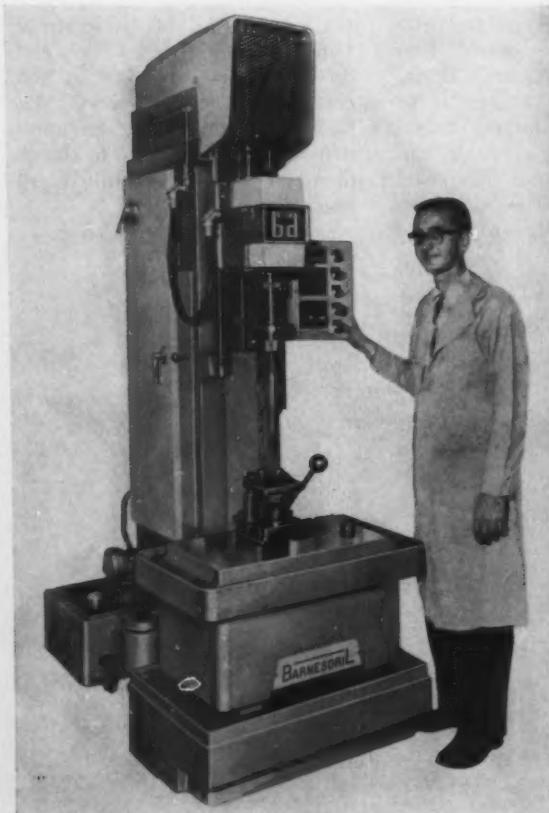
and the hydraulic tank is in the open at the rear of the column.

Operating controls are mounted at shoulder height, and setup controls are protected by a locked cover to avoid undesirable changes once the setup has been made. A simplified electric hone-expansion unit controls the infinite hone-feed adjustment. Rapid expansion, rapid collapse, and automatic compensation for stone wear also are electrically controlled. Infinitely variable speeds from 270 to 870 rpm are indicated on the plate on the right of the column.

Circle 569 on Readers' Service Card

### Shear-Speed Gear Shapers

The Michigan Tool Co., Detroit, Mich., has added two machines to its new Series 3000 twin-column Shear-Speed gear shapers. The new Model 3053 is for gears from 3 to 5 inches in diameter, and the Model 3073 for gears from 5 to 7 inches in diameter. These are companion machines to the 30136 for gears from 10 to 13 inches and the Model 30206 for gears from 13 to 20 inches in diameter. The operating principle is the same as for the earlier 1800 series machines. Multiple single-point tools feed toward the center while the work reciprocates up



Barnes Drill Co.'s machine for honing small bores



Michigan Tool Co.'s Shear-Speed gear-shaping machine

and down to produce all teeth or forms on the contour of the work simultaneously.

The advantage of the 3000 series machines is that twin-column construction with integral cross-head at the top permits chip removal through the rear of the machine. Open-column design also lends itself better to automatic handling under certain conditions. The new design provides excellent aligning of vertical cutting forces which is important when cutting coarse-pitch wide-face gears such as pump gears. Maximum interchangeability of cutter-heads, fixtures, tooling, etc., between the new Series 3000 and the Series 1800 has been maintained.

Circle 570 on Readers' Service Card

### Tape-Controlled Machine Developed for Job-Lot Production

A machine tool designed to bring production-line efficiency to batch-lot production of parts requiring face and other milling cuts, in addition to drilling, boring, reaming, and tapping operations, has been announced by the Hughes Aircraft Co., Industrial Systems Division, Los Angeles,

Calif. This new production equipment, known as the MT-3 Machining Center, is said to be exceptionally versatile. It will perform machining work on a large variety of parts in sizes up to that containable within a 12-inch cube. This three-station machine has independent spindle-drive motors, each rated at 5 to 7 1/2 hp.

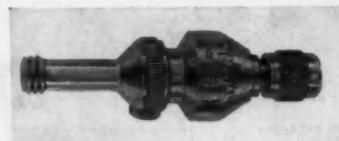
Designed on the building-block principle, the MT-3 has a central positioning table surrounded by three tape-controlled work-heads: (1) a universal drilling, tapping, and boring head with a storage capacity for thirty tools, which changes tools in less than three seconds; (2) a face-milling head; (3) and optionally, a multiple-spindle drill head or a precision boring head with a fourteen-tool capacity changer. The machine may be purchased without the third head if individual manufacturing requirements do not require it.

A Hughes electronic numerical control system directs the operation of the MT-3 Machining Center. Work is positioned in relation to cutters in increments of 0.001 inch to an accuracy of plus or minus 0.0005 inch. Transposition of engineering information from drawing to control tape is

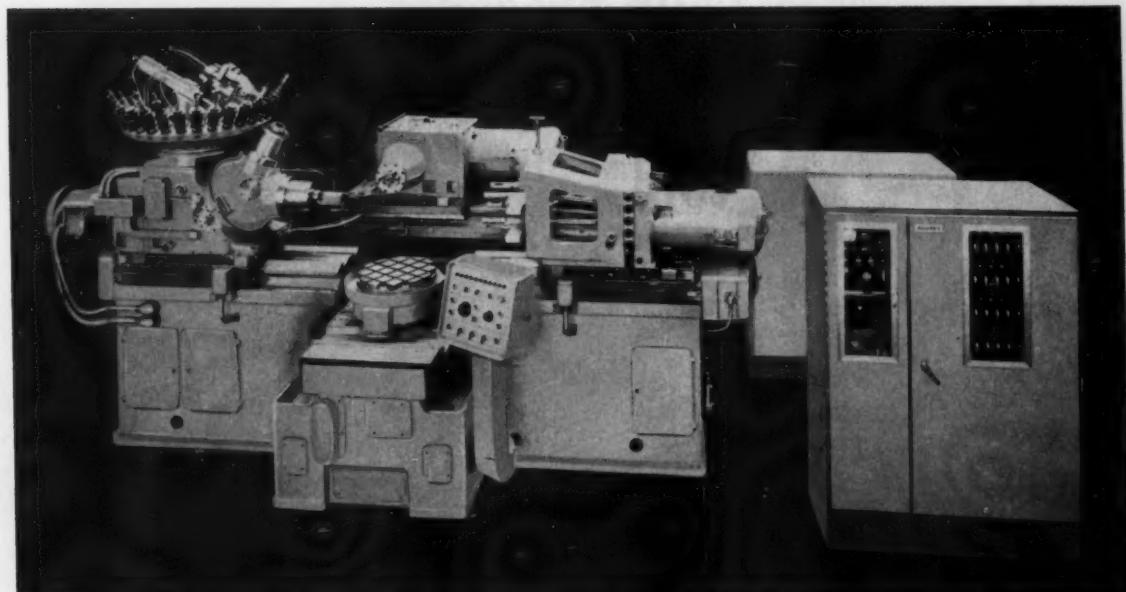
accomplished on an inexpensive tape-preparation unit. No computer is required. Advantages claimed for the MT-3 Machining Center, which result in substantial savings in manufacturing costs, include: (1) reduction of tooling cost by elimination of the requirement of drilling fixtures and a reduction in the number and complexity of milling fixtures required; (2) reduction in non-productive machine time by providing automatic tool changing and eliminating the requirement for manually reorienting fixture and part for each successive operation on a number of conventional machines; and (3) optimization of the machining process by providing a means whereby decisions as to cutter selection, feeds, and speeds can be made on an engineering level and executed precisely as planned by tape command of the tape.

Circle 571 on Readers' Service Card

### SPV New Type Thread Gage



(Continued on page 167)



MT-3 Machining Center machine tool for job-lot production announced by Hughes Aircraft Co.

## See the Hughes two-axis positioning system in operation at the ASTME Show in Los Angeles, Booth 445

Hughes two-axis control system, with positioning table, can be retrofit to almost any kind of drilling machine—single or multiple spindle—or to any other type machine requiring two-axis positioning.

Hughes numerical controls will reduce lead time, eliminate complex jigs and expensive tooling, and increase the productivity of your machine. And, they are easy to operate and service!

The Hughes Positioning Table is automatically operated from pre-programmed taped instructions. The table positions at a rate

of 150 inches per minute; has repeatable accuracy to within 0.0002". Measuring circuit and drive motors are fully integrated.

Installation of this proven system is simple and fast. In many cases, all it takes is one day.

To find out more about how Hughes numerical controls can increase your profits, write, teletype (TWX INGL 4117) or call collect: Hughes Industrial Systems Division, P.O. Box 90904, International Airport Station, Los Angeles 45, California. For export information, please write: Hughes International, Culver City, California.

Creating a new world with ELECTRONICS

**HUGHES**

INDUSTRIAL SYSTEMS DIVISION  
HUGHES AIRCRAFT COMPANY

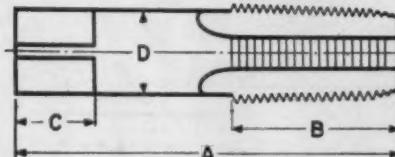


# MACHINERY'S DATA SHEET

## AMERICAN STANDARD CUT AND GROUND THREAD TAPS—23

### Taper Pipe Taps

Carbon Steel—Cut Thread  
High-Speed Steel—Cut Thread  
High-Speed Steel—Ground Thread



General Dimensions

Nominal Size	Threads per Inch		Number of Flutes		Dimensions				
	Carbon Steel	High-Speed Steel	Regu-lar	Inter-rupted	Length Overall A	Length of Thread B	Length of Square C	Diam-eter of Shank D	Size of Square E
$\frac{1}{16}$	..	27	4	..	$2 \frac{1}{4}$	$1\frac{1}{16}$	$\frac{1}{4}$	0.3125	0.234
$\frac{1}{8}$	27	27	4	5	$2 \frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{4}$	0.3125	0.234
$\frac{5}{16}$	27	27	4	5	$2 \frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{4}$	0.4375	0.328
$\frac{1}{4}$	18	18	4	5	$2 \frac{7}{16}$	$1\frac{1}{16}$	$\frac{1}{16}$	0.5625	0.421
$\frac{3}{8}$	18	18	4	5	$2 \frac{7}{16}$	$1\frac{1}{16}$	$\frac{1}{2}$	0.7000	0.531
$\frac{1}{2}$	14	14	4	5	$3 \frac{1}{4}$	$1\frac{1}{16}$	$\frac{1}{4}$	0.6875	0.515
$\frac{5}{8}$	14	14	5	5	$3 \frac{1}{4}$	$1\frac{1}{16}$	$1\frac{1}{16}$	0.9063	0.679
1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	5	5	$3 \frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{16}$	1.1250	0.843
$1\frac{1}{4}$	11 $\frac{1}{2}$	11 $\frac{1}{2}$	5	5	4	$1\frac{1}{4}$	$1\frac{1}{16}$	1.3125	0.984
$1\frac{1}{2}$	11 $\frac{1}{2}$	11 $\frac{1}{2}$	6	7	$4 \frac{1}{4}$	$1\frac{1}{4}$	1	1.5000	1.125
2	11 $\frac{1}{2}$	11 $\frac{1}{2}$	6	7	$4 \frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{4}$	1.8750	1.406
$2\frac{1}{2}$	8	..	8	..	$5 \frac{1}{2}$	$2 \frac{1}{16}$	$1\frac{1}{4}$	2.2500	1.687
3	8	..	8	..	6	$2 \frac{1}{16}$	$1\frac{1}{4}$	2.6250	1.968

All dimensions are given in inches. The  $\frac{1}{8}$ " pipe tap is furnished with large size shank unless the small shank is specified.

The following styles and sizes are standard:

- (a)  $1/8$  in.-3 in. carbon steel, regular thread, right hand, NPT
- (b)  $1/8$  in.-2 in. high-speed steel, regular cut thread, right hand, NPT
- (c)  $1/8$  in.-2 in. high-speed steel, interrupted cut thread, right hand, NPT
- (d)  $1/16$  in.-2 in. high-speed steel, regular ground thread, right hand, NPT, NPTF and ANPT
- (e)  $1/8$  in.-2 in. high-speed steel, interrupted ground thread, right hand, NPT, NPTF and ANPT

### Tolerances\*

Element	Range Nominal Size	Direction	Tolerance	
			Cut Thread	Ground Thread
Length Overall (A)	$\frac{1}{16}$ to $\frac{3}{4}$ incl.	Plus or Minus	$\frac{1}{32}$	$\frac{1}{16}$
	1 to 3 incl.	Plus or Minus	$\frac{1}{16}$	$\frac{1}{16}$
Length of Thread (B)	$\frac{1}{16}$ to $\frac{3}{4}$ incl.	Plus or Minus	$\frac{1}{32}$	$\frac{1}{16}$
	1 to $1\frac{1}{4}$ incl.	Plus or Minus	$\frac{1}{32}$	$\frac{1}{32}$
Length of Square (C)	$\frac{1}{16}$ to $\frac{3}{4}$ incl.	Plus or Minus	$\frac{1}{32}$	$\frac{1}{16}$
	1 to 3 incl.	Plus or Minus	$\frac{1}{32}$	$\frac{1}{32}$
Diameter of Shank (D)	$\frac{1}{16}$ and $\frac{1}{8}$	Minus	0.007	0.0015
	$\frac{1}{8}$ to $\frac{1}{2}$ incl.	Minus	0.007	0.002
	$\frac{1}{4}$ and 1	Minus	0.009	0.002
	1 $\frac{1}{4}$ to 3 incl.	Minus	0.009	0.003
Size of Square (E)	$\frac{1}{16}$ and $\frac{1}{8}$	Minus	0.004	0.004
	$\frac{1}{8}$ to $\frac{1}{2}$ incl.	Minus	0.006	0.006
	1 to 3 incl.	Minus	0.008	0.008

All dimensions are given in inches.

\*For eccentricity tolerances of tap elements, see table in MACHINERY'S Data Sheet, Published in February, 1960, page 168.

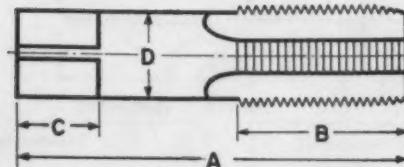
Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

# MACHINERY'S DATA SHEET

## AMERICAN STANDARD CUT AND GROUND THREAD TAPS—24

### Straight Pipe Taps

High-Speed Steel—Cut Thread  
High-Speed Steel—Ground Thread



General Dimensions

Nominal Size	Threads per Inch	Number of Flutes	Dimensions				
			Length Overall A	Length of Thread B	Length of Square C	Diameter of Shank D	Size of Square E
$\frac{1}{8}$	27	4	2 $\frac{1}{8}$	$\frac{3}{4}$	$\frac{3}{8}$	0.3125	0.234
$\frac{1}{8}$	27	4	2 $\frac{1}{8}$	$\frac{3}{4}$	$\frac{3}{8}$	0.4375	0.328
$\frac{1}{8}$	18	4	2 $\frac{7}{16}$	$1 \frac{1}{16}$	$\frac{7}{16}$	0.5625	0.421
$\frac{1}{8}$	18	4	2 $\frac{7}{16}$	$1 \frac{1}{16}$	$\frac{1}{2}$	0.7000	0.531
$\frac{1}{8}$	14	4	3 $\frac{1}{8}$	$1 \frac{3}{8}$	$\frac{1}{2}$	0.6875	0.515
$\frac{1}{8}$	14	5	3 $\frac{1}{8}$	$1 \frac{3}{8}$	$1 \frac{11}{16}$	0.9063	0.679
1	11 $\frac{1}{2}$	5	3 $\frac{1}{8}$	$1 \frac{3}{8}$	$1 \frac{11}{16}$	1.1250	0.843

All dimensions are given in inches.

These taps are furnished in plug style only.

The  $\frac{1}{8}$ " pipe tap is furnished with large size shank unless the small shank is specified.

The following styles and sizes are standard:

(a)  $\frac{1}{8}$  in.-1 in., high-speed steel cut thread, right hand, NPS, NPSC and NPSM

(b)  $\frac{1}{8}$  in.-1 in., high-speed steel ground thread, right hand, NPS, NPSC and NPSM

(c)  $\frac{1}{8}$  in.- $\frac{1}{2}$  in., high-speed steel ground thread, right hand, NPSF

American Standard cut thread pipe taps are made from under to over basic, as shown in Table 334, to permit a taper pipe gage to enter up to the notch. Therefore, a basic straight pipe gage will not always enter a threaded hole tapped with a cut thread straight pipe tap.

All taps have internal center in thread end.

### Tolerances\*

Element	Range Nominal Size	Direction	Tolerance	
			Cut Thread	Ground Thread
Length Overall (A)	$\frac{1}{8}$ to 1	$\frac{1}{8}$ incl.	Plus or Minus $\frac{1}{32}$	$\frac{1}{32}$
			Plus or Minus $\frac{1}{16}$	$\frac{1}{16}$
Length of Thread (B)	1	$\frac{1}{8}$ to $\frac{1}{4}$ incl.	Plus or Minus $\frac{1}{16}$	$\frac{1}{16}$
			Plus or Minus $\frac{3}{32}$	$\frac{3}{32}$
Length of Square (C)	1	$\frac{1}{8}$ to $\frac{1}{4}$ incl.	Plus or Minus $\frac{1}{32}$	$\frac{1}{32}$
			Plus or Minus $\frac{1}{16}$	$\frac{1}{16}$
Diameter of Shank (D)	$\frac{1}{8}$ $\frac{1}{4}$ to $\frac{1}{2}$ incl. $\frac{1}{4}$ and 1		Minus 0.007	0.0015
			Minus 0.007	0.002
			Minus 0.009	0.002
Size of Square (E)	1	$\frac{1}{8}$ incl.	Minus 0.004	0.004
			Minus 0.006	0.006
			Minus 0.008	0.008

All dimensions are given in inches.

\*For eccentricity tolerances of tap elements, see table in MACHINERY'S Data Sheet, Published in February, 1960, page 186.

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

LINDE  
COMPANY

UNION  
CARBIDE

SIGMA

# SIGMATIC

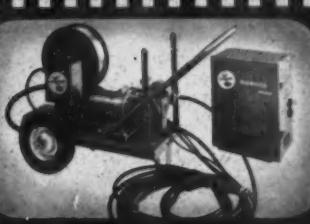
## NEW ALL-IN-ONE "MIG" WELDING EQUIPMENT

Welding equipment is designed, developed and refined, but eventually it must be redesigned. LINDE'S new SIGMATIC line of "Mig" welding equipment is a product of this evolution...plus LINDE'S vast experience with more inert-gas and consumable-electrode processes than any other company in the world. The SIGMATIC line is the most versatile semi-automatic equipment available anywhere—one machine for:

- ...all types of "Mig" welding—spray arc, short arc and spot welding
- ...in all welding positions—vertical, overhead or downhand
- ...with all shielding gases—argon, helium, CO<sub>2</sub>, or their mixtures
- ...and all wires—hard or soft, solid or tube
- ...on all weldable metals—carbon steel, stainless, aluminum, magnesium, titanium
- ...on all thicknesses—sheet metal and up

See next page for details.

# SIGMATIC



One SIGMATIC machine for...



spray arc...



short arc...



spot welding

Spray arc, short arc, spot welding...never before combined in a single piece of equipment. SCC-8 control incorporates special spot-welding circuitry, featuring a directly-calibrated, precision weld timer and an independently-adjustable, "non-stick" timer. Converts from spot to continuous fusion welding at the flick of a switch. SEH-2 heavy-duty wire-feed unit—largest, most-rugged unit available today—permits positive feed of all "Mig" wire types, metals and diameters. The SIGMATIC line contains five basic units, designed with interchangeable parts permitting more than 50 combinations tailor-made to individual specifications. Available in cart-, sled- or bench-type units.

Unique controls are vastly simplified. All components are visible and accessible. Adjustments can be made with a screw driver. Only heavy-duty industrial-type parts are used throughout each unit to insure dependable, long-life performance with minimum maintenance. Top-quality parts—"Square D" pneumatic timers, Mallory electrolytic condensers, Cutler-Hammer switches, Potter & Brumfield relays, Electrons, Inc. thyratron tubes. The SIGMATIC line is unquestionably a major welding advance—with one rugged, durable machine, you can do any type of "Mig" welding in any position on any thickness of any metal. For more information or a live demonstration, call your nearest Linde office.

"Linde," "Sigmatic" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

LINDE  
COMPANY

UNION  
CARBIDE

Division of Union Carbide Corporation  
270 Park Avenue, New York 17, N.Y.

This SPV universal thread gage, type ATG, is now available from Homestrand Machine Tool Corporation, Greenwich, Conn. It is an instrument by which the pitch diameter of internal threads can be measured with high accuracy (0.0002 inch). The extent of the

error is directly readable. The ATG can also be used as a maximum gage adjustable to various tolerances and as a maximum/minimum gage for stud bolt fits. Wear is compensated for by zero setting with a master ring.

Circle 572 on Readers' Service Card

### Mattison Vertical-Spindle Rotary Surface Grinder

A one-piece, box type column backs up a spindle that delivers as high as 125 hp on the No. 24 vertical-spindle rotary surface grinder announced by Mattison Machine Works, Rockford, Ill. This new grinder, with a 48-inch-diameter capacity, combines Mattison's Quick-Tilt grinding head with the box type column and increased horsepower. It is said that, for the first time on this class of machine, accuracies measured in tenths of a thousandth of an inch can be combined with high-production stock removal. On average grinding operations, it is claimed that production can be increased by 50 per cent, or more, without sacrificing flatness or finish.

The one-piece column of the

machine is bolted and keyed to the base, forming the equivalent of a single L-shaped Meehanite casting. Grinding-wheel thrust is downward onto the table and rearward into the column. Thus, deflection and vibration are said to be virtually eliminated. Uniform cross ribbing in the heavy, double-walled base provides rigid support under the table. Both bed and column are stress-relieved by heat-treating.

Power spindle tilting converts the No. 24 for roughing or finishing in a few seconds. Formerly, grinding for stock removal required lost time for manually adjusting the spindle, particularly when centering the work under the low point of the wheel's ellipse. Mattison's Quick-Tilt spin-

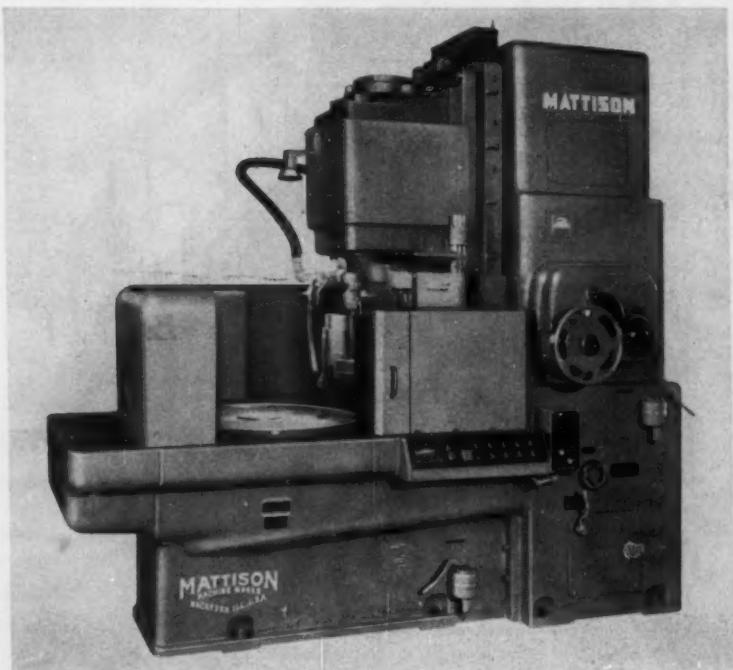
dle solves this problem by using wheel tilt to rough-grind parts to within a few thousandths of final size. Location of the low point has no effect on final accuracy because, with a flip of the switch, the wheel is automatically returned to the dead flat position for a finish grind without changing the setup. A pneumatic cylinder actuates the spindle-tilting mechanism.

The primary reason for increasing the spindle-driving horsepower and structural rigidity is to take advantage of grinding-wheel improvements. Downfeed of the grinding wheel is continuous from 0.005 to 0.165 ipm. When work reaches the desired size, the wheel is disengaged instantly by a preset stop. Continuous downfeed makes it possible to split the last increment of a ratchet type feed and thus increase accuracy.

A choice of automatic sizing systems is offered to control quality and cycle time. Both continuously measure the work-piece during the cut, with positive controls sensing actual size of work as it is ground. An air-gaging system provides visual and electrical indication when work approaches size. The electrical-mechanical system actuates the automatic cycle and returns the machine to reload condition when the preset size is reached. By either method, operators can set maximum feed, then grind to size in one uninterrupted cut without miking.

To minimize thermal expansion and vibration which might affect accuracy of the grind, coolant is contained in a tank outside the base. This method also eliminates machine down time for removal of sludge from the base. Newly matched to the increased rigidity and horsepower are cylinder wheel capacities of up to 22 by 4 by 18 inches and segmental wheel sizes of up to 22 by 6 by 19 inches. Increased minimum capacity for the coolant pump, from 50 to 75 gallons per minute, also keeps pace with higher grinding speeds available on the new machine. The No. 24 uses 30-through 42-inch magnetic chucks, with an alternate 48-inch swing available.

Circle 573 on Readers' Service Card



Mattison rotary grinder with Quick-Tilt vertical-spindle head

## Automatic Indexing Machine for Processing Steering-Gear Housings

Greenlee Bros. & Co., Rockford, Ill., announces the delivery of an eight-way, eight-station, horizontal and vertical automatic indexing machine built to process aluminum steering-gear housings. The machine produces 153 housings per hour, performing rough-boring as well as semifinishing, generating, drilling, countersinking, tapping, and cross-facing operations.

The 52-inch-diameter table, mounted on frictionless bearings, is automatically indexed by a fluid motor which actuates a worm and wheel and is located with a hydraulically actuated shot pin. To insure rigidity and accuracy, the table is hydraulically clamped—metal to metal—in three places. Rough castings are located on

three cast lugs and power-clamped by a tunnel type column through which a horizontal tap unit traverses. The multiple-spindle heads were designed to accommodate change-gears to vary spindle speeds. The complete coolant system provides also for disposal of aluminum chips.

Circle 574 on Readers' Service Card

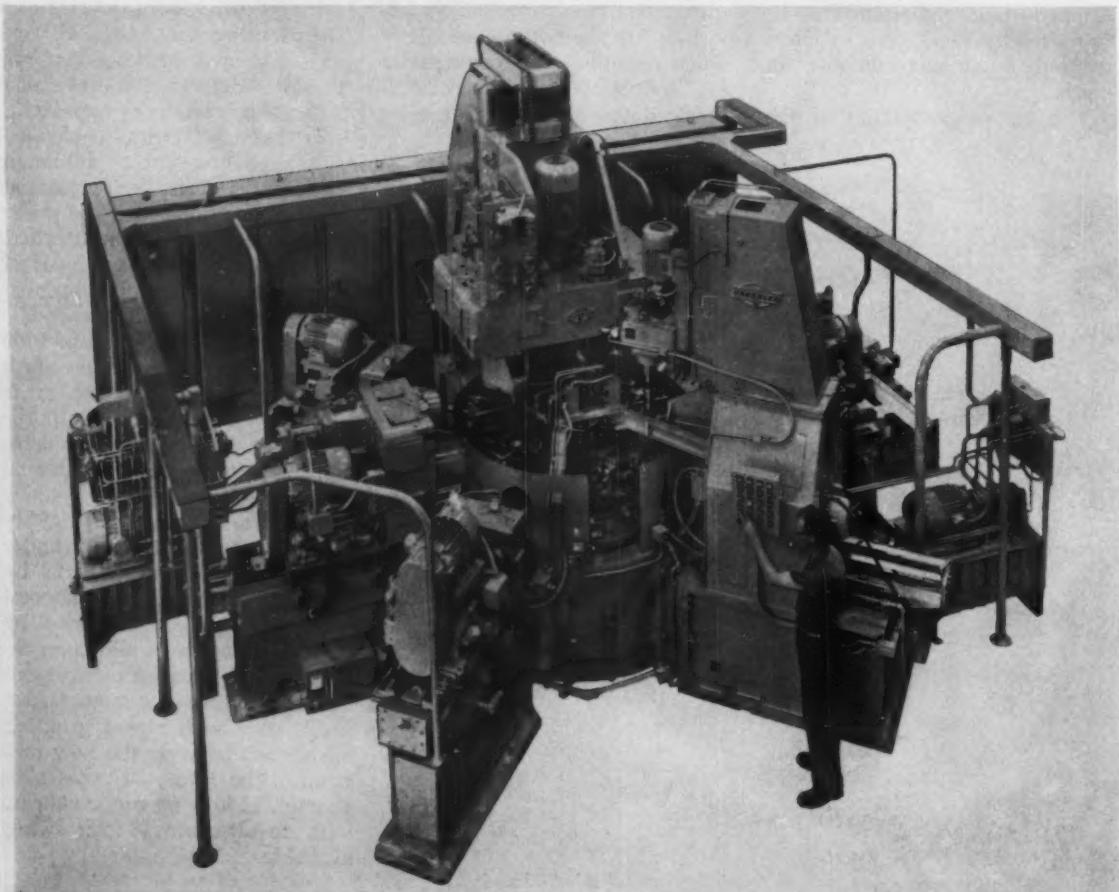
## Bijur Automatic Lubricating System

A fully automatic lubricating system which continuously circulates clean, filtered lubricant through machine bearings at controlled rates is a development of the Bijur Lubricating Corporation, Rochelle Park, N. J. Called

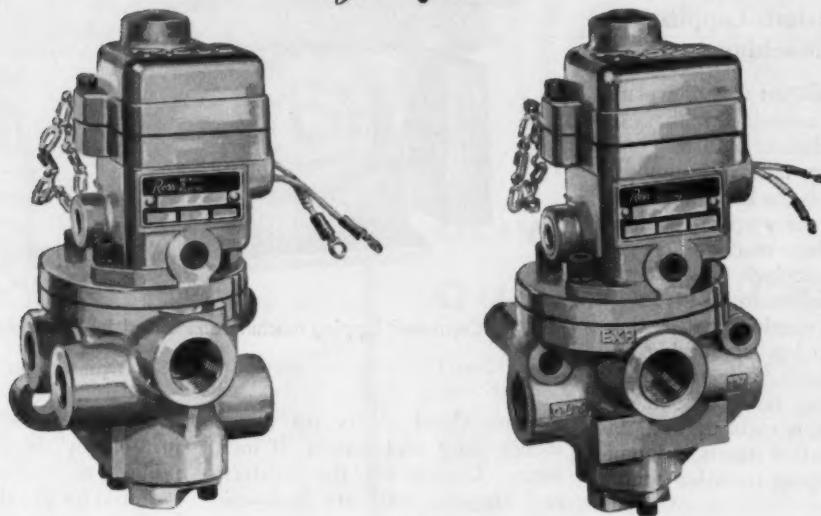
"Circulube," this new system is designed to provide machine builders with a dependable means of centralized automatic lubrication which controls oil circulation through machine bearings and provides for its re-use. The lubricant is pumped to bearings through the system, and returned by tubing or piping.

The Circulube system consists of a lubricator, a distribution system, and the control units which determine flow of oil to bearings. An additional special feature of the system is a pressure signal switch which prevents machine operation until proper oil pressure has been developed. Three basic lubricator models are available. They are identified as follows: CLFB, a unit with a 2-gallon reservoir and a single outlet connection for continuous oil delivery; a CLFC unit similar to type CLFB,

Eight-station indexing machine announced by Greenlee Bros. & Co.



**Ross**  
*Proudly presents*



THE NEW "HEADLINE" SERIES

*A complete new series of inline valves, sizes one-quarter inch through one and one-half inch, straightway, 3-way and 4-way. These valves, size for size, will operate faster, longer, and provide greater capacity than any other valves we have been able to find.*

*When the price, quality and performance and Ross reputation are taken together in evaluating this series, it represents probably the best valve value available today. Before you specify any valve after today, you owe it to yourself to look into the "headline" series. Write for full information.*

---

**Ross** OPERATING VALVE COMPANY

110 EAST GOLDEN GATE AVE. • DETROIT 3, MICHIGAN

but equipped with a second outlet connection from which oil is delivered cyclically in small controlled quantities; and a CLWB unit with a 1/2-gallon reservoir and a single outlet connection intended for small machines.

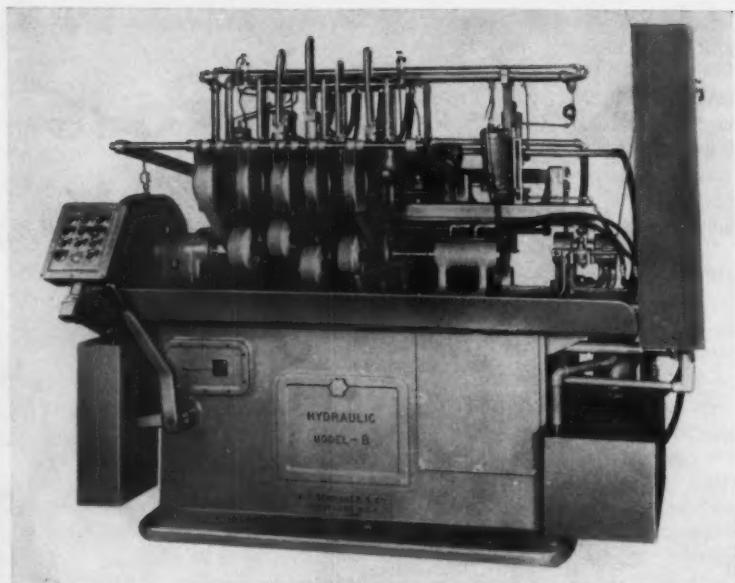
Circle 575 on Readers' Service Card

### Footburt-Schrader Crankshaft-Lapping Machine

The Foote-Burt Co., Cleveland, Ohio, has announced that the Footburt-Schrader line of crank-shaft-lapping machines now includes models for handling crankshafts of all sizes up to 84 inches in length. These machines provide a 4- to 7-micro-inch finish at production rates up to 60 pieces an hour. They employ coated abrasive cloth to lap all bearing and oil-seal surfaces. Bearing surfaces and fillets can be lapped in one operation. It is claimed that this work is handled more economically by lapping than by honing or grinding.

Footburt-Schrader crankshaft-lapping machines, like all other Footburt-Schrader shaft-finishing machines, have the exclusive "no master crank" feature. They do not require master cranks to guide the work. When each lapping cycle is finished, a simple clamping device locks the arms in place, leaving them aligned for the next part. Thus no setup time or major adjustment is required when changing runs. The lapping heads can be relocated quickly for different runs simply by loosening one screw in each, moving the heads to the new spacing, and retightening the screws.

To obtain the best lapping action, the shaft is oscillated as it rotates against the lapping heads. This is accomplished by a unique spindle assembly that combines rotary and axial motion. The crankshaft-lapping machines are available with any required number of heads, depending on the user's needs. They come in three adjustable models. Model A takes cranks up to 24 inches long with swings up to 12 inches. Model B takes shafts up to 40 inches long with a 12-inch swing. Model HD



Crankshaft-lapping machine announced by the Foote-Burt Co.

accommodates shafts up to 84 inches long and has a 16-inch swing. Clamps for the tailstock and lapping arms are hydraulically operated.

Circle 576 on Readers' Service Card

### Loungway Rise-and-Fall Belt Grinder

A Loungway rise-and-fall abrasive belt grinder developed by the Eastern Machine Screw Corporation, New Haven, Conn., is said to be the first of its type to be able to rough- and finish-grind contours automatically in one cycle in a matter of seconds. The machine, shown in Fig. 1, comes equipped with either single- or double-spindle assemblies.

The double-spindle unit allows two rough grinds and one finish grind per cycle. Maximum work size is 4 by 6 inches. Small parts can be ganged for multiple grinding. The work travels on a table operated by an air motor and hydraulic check units, and a special cam produces rapid indexing to each grinding position. A follower on the spindle assembly follows the rise-and-fall cam attached to the work-fixture, which enables fast change-over on jobs.

The speed of each spindle is adjustable by using different drive pulleys, so that it can be set as required for grinding, finishing, or buffing. A counterbalance assembly allows rapid adjustment on belt pressure.

Other features of the equipment include: a floating piston for even pressure on abrasive belts, quick change of belts, and special adjustments for belt alignment and

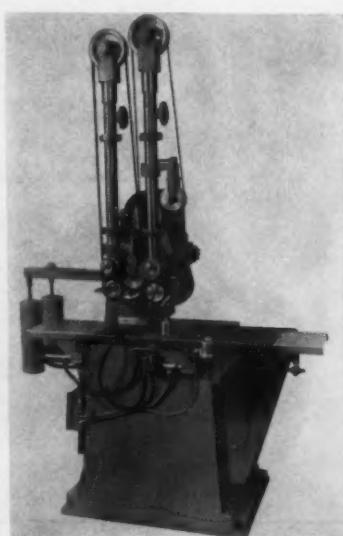
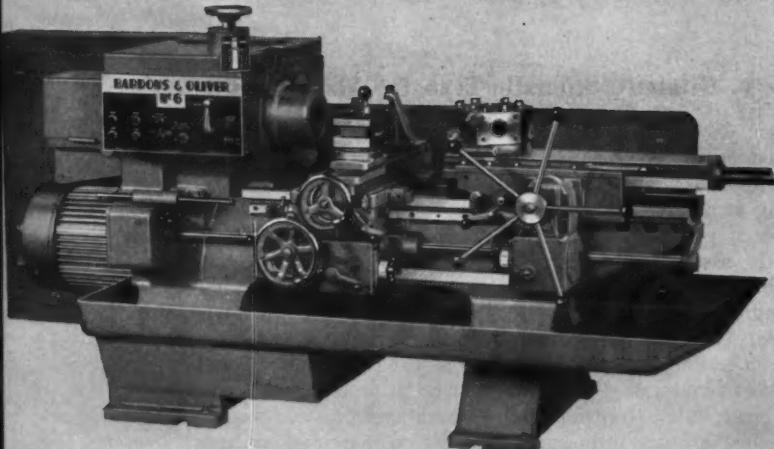


Fig. 1. Loungway rise-and-fall abrasive belt grinder



#### RAM TYPE TURRET LATHES

Size	Bar Capacity	Swing Over Bed
No. 2 Geared Electric	1" or 1½"	13½"
No. 3 Universal	1½" or 2"	15½"
No. 4 Universal	2" or 2½"	18¼"
No. 6 Universal	3" or 5"	21½"

SADDLE TYPE TURRET LATHE		
No. 21 Universal	3" or 4½"	21¼"

#### BARDONS & OLIVER

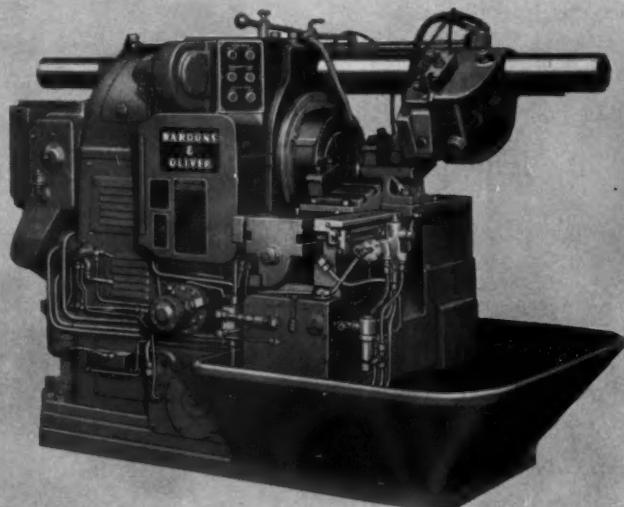
### Turret Lathes . . .

Each of the five Turret Lathes listed is a completely different machine, designed specifically for one range of work. All units on each machine, including the cross slide and carriage, and the turret slide and saddle, are "sized" for a particular work range. Thus adequate strength and rigidity is provided, maximum productive capacity is offered, and at the same time minimum operator effort is required. A complete line of tooling and attachments is available for each size of machine.

### Cutting-Off Lathes

The Cutting-Off Lathes are designed to chamfer, form and cut off pipe, tubing, or bar stock with maximum efficiency. The number of pieces produced per hour often equals or exceeds that of much more expensive and complicated multiple spindle machines. Automatic loading tables, chamfer attachments, forming attachments, and automatic unloading devices are available for all sizes of Cutting-Off Lathes. These lathes are built as fully automatic, semi-automatic or hand operated.

CUTTING-OFF LATHES	
Size	Capacity
No. 32	2"
No. 33 and 34	3" and 4"
No. 35 and 36	5½" and 6½"
No. 38 and 39	8½" and 9½"
No. 312 and 314	12¾" and 14½"
No. 316	16"



## BARDONS & OLIVER

BARDONS & OLIVER, INC., 1133 WEST 9th ST., CLEVELAND 13, OHIO

Manufacturers of Turret Lathes and Cutting-Off Lathes

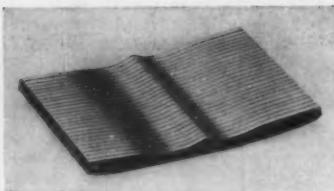


Fig. 2. Processing twenty-eight parts at a time

tracking. Fig. 2 shows how a difficult rise-and-fall problem in processing a jackknife spring is solved. Twenty-eight parts are handled at a time.

Circle 577 on Readers' Service Card

### Leitz Vertical Gage

A Leitz vertical gage with a direct-measuring range between 0 and 4 inches from a master glass scale is being offered by Opto-Metric Tools, Inc., New York City. The instrument has a stand of sufficient height to permit an optional increase of the measuring range to 8 inches, by resetting to a 4-inch gage-block. The scale interval of 0.050 inch is subdivided into 0.000025-inch steps by an optical micrometer. All readings are on projection screens and so organized that they are foolproof. A large assortment of anvils and contact tips is available.

Circle 578 on Readers' Service Card

### Gilman Automatic Transfer Assembly Machines and Dial Type Bases

A sixteen-station, automatic Transferline assembly machine operating at a production rate of 2880 pieces per hour was demonstrated assembling six-piece Parker ball-pen caps by the Gilman Engineering & Mfg. Co., Janesville, Wis., at the Production Engineering Show in Chicago. This machine uses standard Gilman straight-line transfer and loading mechanisms throughout. All stations are actuated by cams mounted on a single camshaft ex-

tending the length of the machine. Building-block station design permits modification of the line for model changes at minimum cost for retooling.

A second fourteen-station Transferline machine—with sample standard stations mounted and operating—was also shown. It illustrated the range of assembly operations possible using Gilman unitized patented station movements and other components and controls.

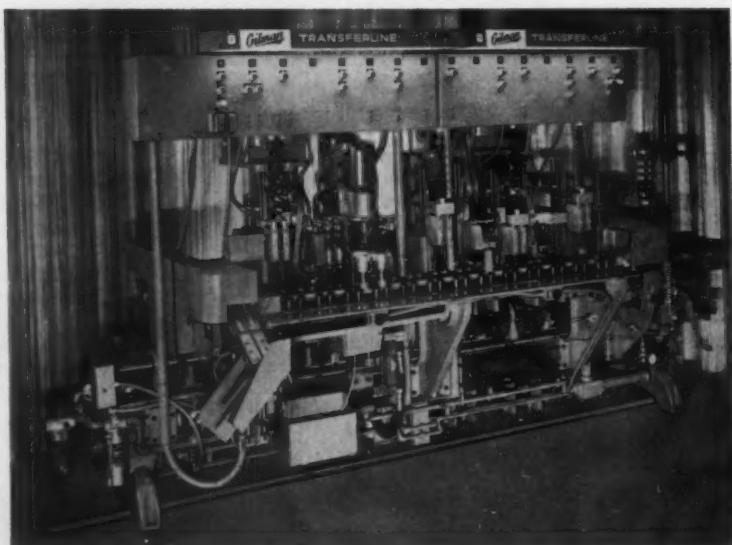


Fig. 1. Sixteen-station Transferline automatic assembly machine manufactured by the Gilman Engineering & Mfg. Co.

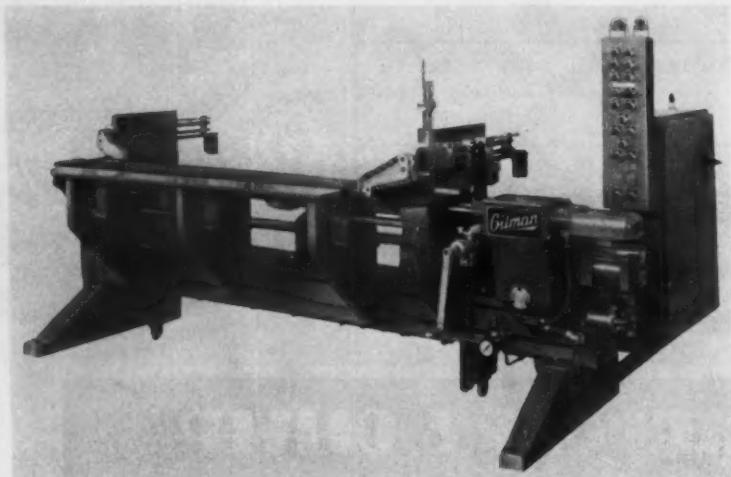
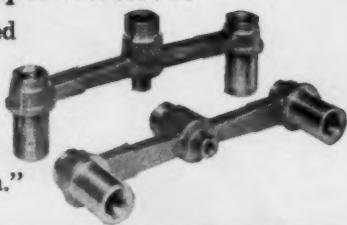


Fig. 2. Gilman basic Transferline assembly machine

## **WANTED!** Production line economies for market exploration...

At Bardes Corporation in Cincinnati, Milt Garvin, Vice President, talked over this problem with his Cincinnati Lathe and Tool distributor. "We continually develop new plumbing products—like this faucet body which has 30 operations including drilling, hollow milling, boring, tapping and threading. We'll use a transfer machine when we hit high volume. Right now we need a machining line for low-cost, diversified small-lot production."



## **DELIVERED!** A low-cost machining line from standard machine tools...

Four CINCINNATI 21" Sliding Head Drills—one 4-spindle and three 2-spindle models—were arranged in line and tooled to provide a production rate of 125 pieces per hour net on the brass faucet body. Total cost for the drilling machines only \$27,500!



This type of production line is ideal for market exploration, or for testing tooling arrangements for a transfer line. When the low volume job is finished, these standard machines are ready for use on other jobs, including development of another new product!

Let Cincinnati Lathe and Tool sales engineers help solve your drilling problems the cost-reducing CINCINNATI way! Call your CL&T Distributor, or write direct.

Bardes' new standard-machine transfer line  
for low-volume plumbing equipment.

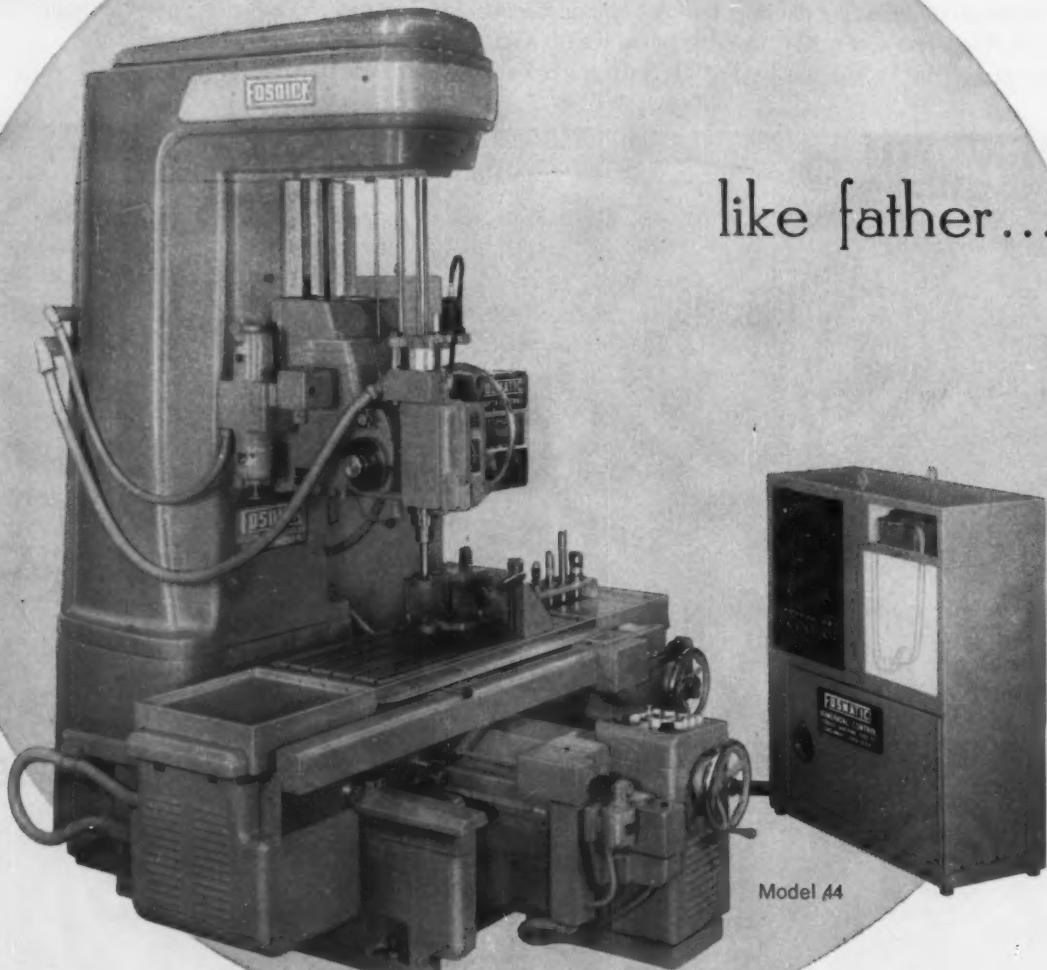
**CINCINNATI LATHE AND TOOL CO.**

Cincinnati 9, Ohio

HYDRASHIFT Lathes • CINCINNATI Drilling Machines • SPIROPOINT Drill Sharpeners



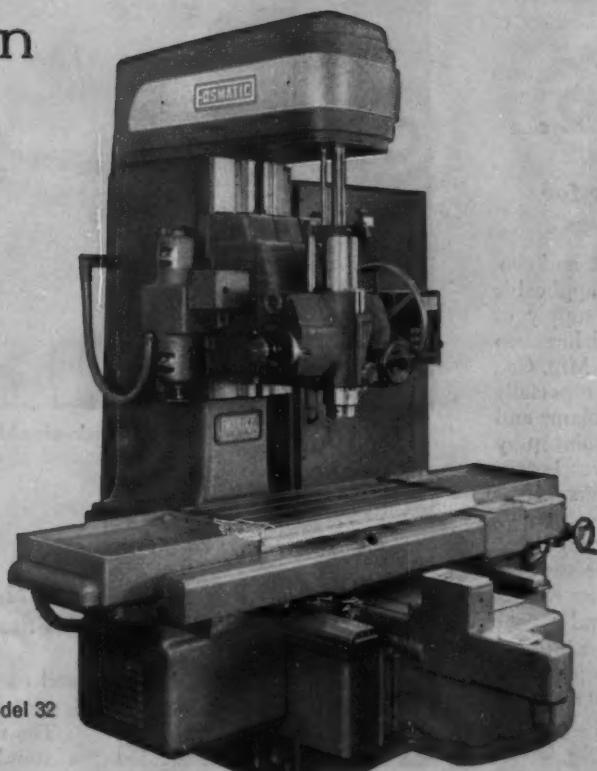
like father...



Model 44

Specifications	32	42	44	54
Table working surfaces	18" x 32"	18" x 42"	44" x 22"	54" x 22"
Table travel	18" x 30"	20" x 36"	22" x 42"	28" x 48"
Spindle nose to table top	4" to 22½"	4" to 28½"	6" to 30"	6" to 30"
Spindle center to column face	16½"	16½"	18½"	18½"
Spindle center to column throat	21"	21"	25½"	30½"
Column throat to table top	16"	16"	22"	22"
Head travel on column	9½"	15½"	15"	15"
Spindle travel in head	9"	9"	9"	9"
Speeds	62-3000 rpm	62-3000 rpm	30-1800 rpm	30-1800 rpm
Feeds— inches per revolution	.0005 to .015	.0005 to .015	.0005 to .015	.0005 to .015
Motor	3 hp	3 hp	3 hp	3 hp
Floor space (without numerical control)	98" x 120"	98" x 134"	123" x 140"	134" x 156"
(numerical control console)	25" x 48"	25" x 48"	25" x 48"	25" x 48"
Net weight	10,000 lb.	11,000 lb.	21,500 lb.	23,500 lb.

...like son



Model 32

## New Compact Jig Borers

Like father like son, the same features that made the reputation of the big Fosmatic 44 and 54 Precision Boring Machines are now available in two smaller size machines, the Model 32 with 18" x 30" table travel, and the Model 42 with 20" x 36" table travel.

These completely new machines are ideal for boring jobs on missile parts and similar delicate jobs that require extreme accuracies. The 32 and 42 are equally at home on jig-boring jobs in the toolroom, or on extended production runs.

Like the big Fosmatics, they offer direct dimension measuring for establishing locations quickly by direct-reading dials. They also give you automatic positioning that brings table and saddle into location at the touch of a button to accuracies of  $\pm .0001"$ . Push-

button control of speeds and feeds is standard on both jig borers. Numerical control? Absolutely! The same full Fosmatic numerical control in three dimensions, outstandingly successful on big 44 and 54, is also available on the 32 and 42.

If you have been wishing for a smaller machine with the big Fosmatic features, then the 32 and 42 are just what you asked for. Call your Fosdick distributor to learn more about these two new members of our family. And get a proposal from Fosdick!

THE FOSDICK MACHINE TOOL CO.  
CINCINNATI 23, OHIO

**FOSDICK**

Also included in the exhibit were three basic Gilman dial type Indexamatic units for dial and carousel type assembly machines and standardized untooled bases for mounting index units and standardized station movement mechanisms. The basic Transferline machine shown in Fig. 2 consists of a standard drive, drive control, platen transfer unit, air counterweight control, and electrical system. Standard units of this type are available to customers who wish to tool their own machines.

**Circle 579 on Readers' Service Card**

### Filter Regulator for Control Systems

A rugged, lightweight, and economical filter regulator, applicable wherever a controlled supply of clean air or gas is needed, has been introduced by Rockwell Mfg. Co., Pittsburgh, Pa. It is especially suited for single-unit hookups and production equipment, paint spray units, air chucks, gas drives, instruments, and air cylinders. Constructed of pressure die-cast aluminum, the No. 080 filter regulator has a maximum inlet pressure of 250 psi and outlet-pressure ranges of 0 to 5, 5 to 35, and 35 to 100 psi. Optional construction includes a handwheel adjustment and 1/4-inch side outlet tap for pressure-gage mounting.

**Circle 580 on Readers' Service Card**

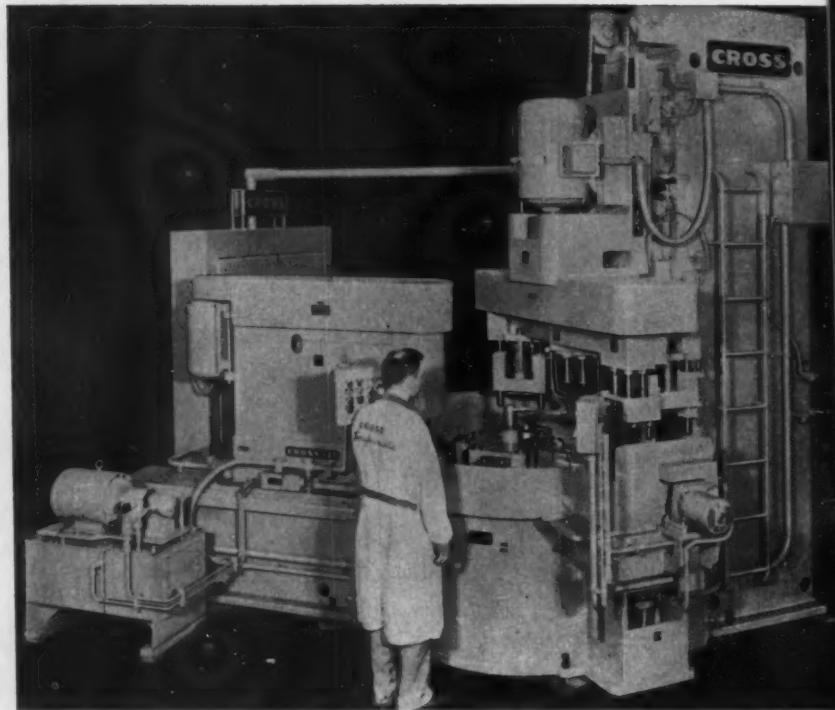


Fig. 1. Four-station dial machine developed by The Cross Co., which has a fifth station off of the dial

### Cross Four-Station Dial Machine with Stationary Fifth Station

The Cross Co., Detroit, Mich., has recently developed an unusual four-station dial machine which has a fifth station located off the dial. This unconventional location of the fifth station is said to result in a smaller machine with fewer fixtures than would have been needed had the design followed conventional lines. The operator has more time to load and unload fixtures; cost of the machine is reduced; and the production rate is about 262 parts per hour at 80 per cent efficiency. This machine (Fig. 1) was designed especially for flexibility, and at the present time it is processing two different sizes of rear-axle carrier-bearing caps, such as shown in Fig. 2. Operations on the dial include: milling of the flats, drilling of holes to half depth, and drilling to full depth. Caps are turned over as they are loaded in the fixture of the off-dial station

and each of the holes in the cap is spot-faced.

The milling cutter is carried on a standard horizontal hydraulic feed unit and all of the remaining tools, including the spot facers in the off-dial station, are carried in a special head mounted on a standard vertical hydraulic feed unit. In operation, the attendant unloads two caps from the unclamped fixture in the load position, Fig. 3, and places them on a shelf adjacent to the off-dial station. He loads two raw parts in the dial fixture, actuates the hydraulic clamp, and then initiates the dial-index and milling-head cycles. During dial indexing, he loads the two partially finished parts from the shelf into the fixture in the off-dial station, and presses a push button that hydraulically clamps these parts and starts the cycle of the vertical head. During indexing, the dial

# this **3** in **1** machine tool

*combines*

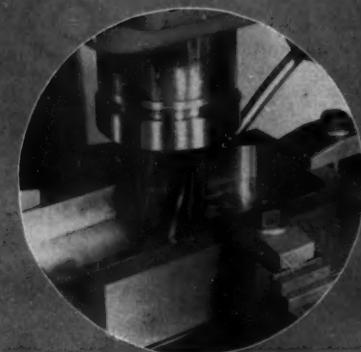
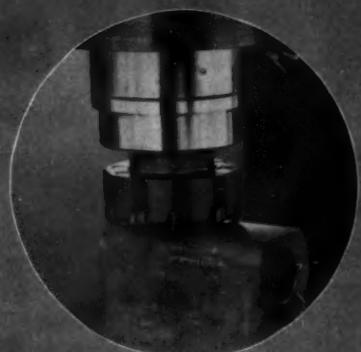
**jig boring**



**vertical milling**



**infeed milling**



**...costs less than a jig borer alone**

Add all the plusses together on this new Hurth V-11 Vertical Boring & Milling Machine and you'll come up with the same answer so many toolrooms agree on: "It's a lot of precision machine for the money!"

It is *that* all right! A 3-way producer that does—

- 1. Jig Boring**—Using continuous spindle down-feed in finely graduated steps.
- 2. Vertical Milling**—Using longitudinal traverse of worktable.
- 3. Infeed Milling**—Using longitudinal traverse of milling head plus intermittent depth feed of cutter spindle.

**ACCURATE?** Precision boring by the coordinate hole location method is guaranteed accurate within .0002" after fine boring. With specially designed optical system, adjustments as small as .0001" can be quickly and easily read. 13 spindle speeds (45 to 2800 rpm) permit selecting the speed that's just right for the cutter diameter and material involved.

**RIGID AND RUGGED?** Worktable has been increased to 48" x 14"; column is wider and throat is 50% deeper than previous model to handle bulky work. Base is more massive—enlarged from 22" to 34". So is the motor—3 h.p. And the machine's 6120 lbs. over-all weight assures vibration-free operation during heavy boring or milling.

There's so much more you'll want to know about this remarkable new Hurth machine than space here permits telling. Our catalog covers all the features in detail and an Orban technical representative will fill in the rest. Why not ask him to stop by?



**KURT ORBAN**  
COMPANY, INC.

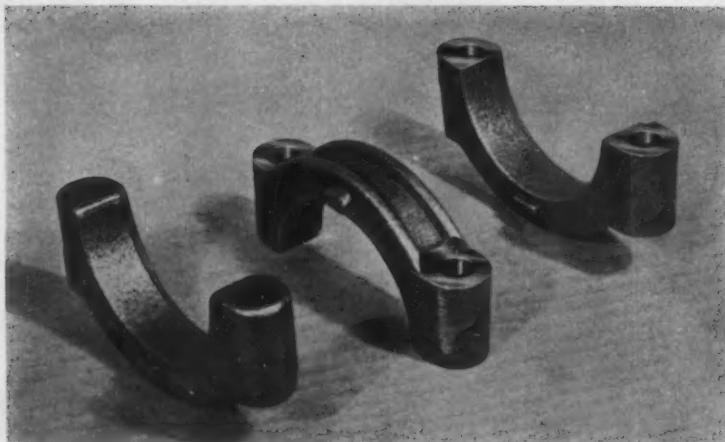


Fig. 2. Unfinished bearing cap, left, shown with two finished caps. Two spot faces shown by the middle part are completed in the off-dial station

fixture, moving into the load-unload station is automatically unclamped so that the attendant can remove the semifinished parts and load two of the raw malleable-iron castings during the machining cycle.

As the vertical head retracts, it initiates a cycle that automatically unclamps the two parts in the off-dial station, Fig. 4, and activates the 360-degree rotation of a pair of arms in that station. These arms pick the parts out of the fixture and automatically transfer them

to a discharge chute; thus the attendant has nothing to do with unloading the finished caps.

As a safety feature, the fixture clamps on the main dial will be automatically actuated if the operator forgets to clamp the parts. In regular operation, the attendant clamps the parts while they are in the load position so that he can see that they are properly seated. Without the safety feature, however, it would be possible for the milling cutters to lift the caps out of the fixture and throw them

with considerable force if the clamps had not been applied.

This machine can be changed from the production of one size of bearing cap to the other in about one and one-half hours. The two parts are different as to height, hole size, and center distance of the holes. No change is required for the milling operation, but the inboard hole locations have to be moved 7/16 inch. To achieve the two locations of the six movable spindles, eccentric spindle-carriers are used. Each spindle-carrier is unlocked, rotated 180 degrees, and locked. Spacers and height blocks in the fixtures are changed to accommodate the new part size. Outboard location is kept constant; therefore the clamp stroke does not have to be varied. The final step in change-over is replacement of the drills and spot facers. Tool changing, for a different part or for regular tool maintenance, is simplified because all tools are preset in adapters off the machine.

#### Push-Pull Clamp

A Model 250 push-pull clamp which locks in both push and pull positions has been added to the Wespo line. The cast-alloy steel

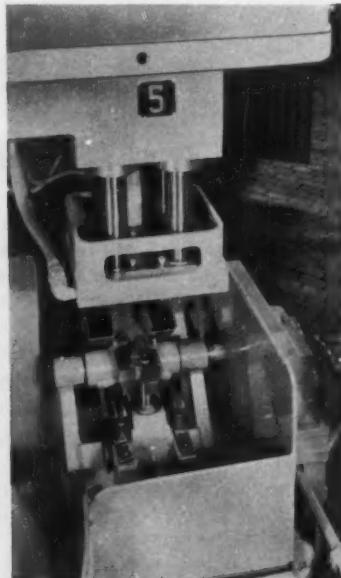
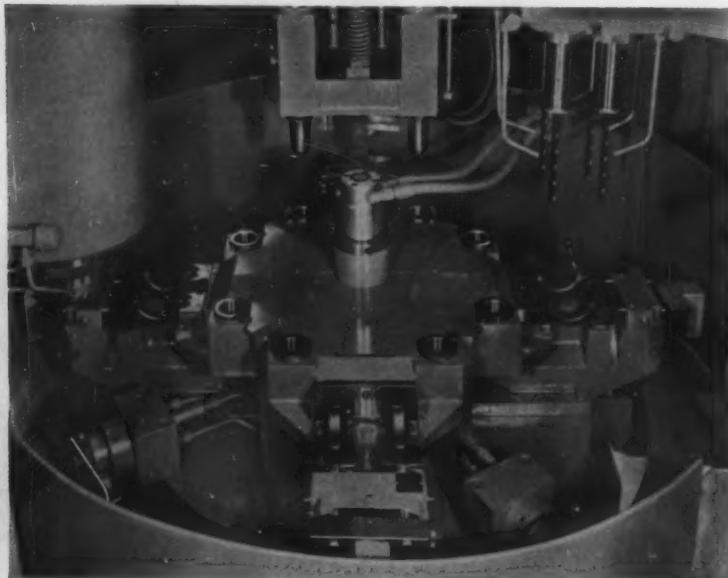


Fig. 3. (Left) Dial table of Cross machine, Fig. 1, as seen from operating position. Fig. 4. (Right) Semifinished parts are placed joint-face-down in off-dial station fixture of machine.

THERE'S A

# CLEVELAND

FOR YOU IN THIS  
ADVANCED, COST-CUTTING  
LINE OF SINGLE SPINDLE  
AUTOMATICS

MODEL

**AW**

AUTOMATICS

2½", 4¼", 5¾"

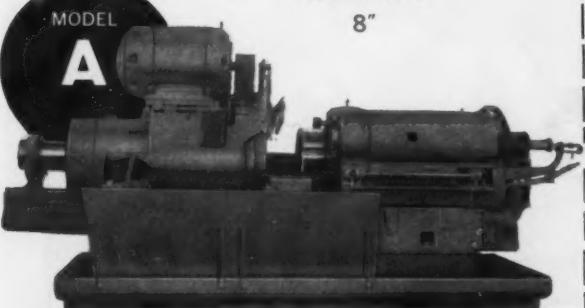
AW's are simplified, lower cost automatics that differ from the AB Dialmatics only in that variable turret feeds are obtained by an improved mechanical drive. These are the "work horse" automatics of many shops.

AUTOMATIC

8"

MODEL

**A**



Powerful, heavy-duty Cleveland machines parts from stock up to 8" dia. with ease and accuracy. Universal camming shortens set-up time.

For full details on Clevelands best suited to your requirements, write direct, or call in a Cleveland field engineer.

Sales Offices: Chicago • Cleveland • Detroit • Hartford • Springfield, N.J.

# CLEVELAND

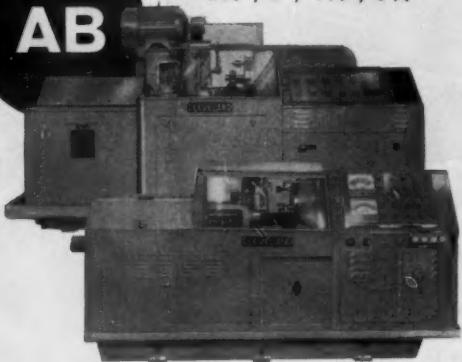
Manufacturers of a Complete Line of Single Spindle Automatic Screw Machines and High Pressure Hydraulic Die Casting Machines

DIALMATICS

1½", 3", 4¼", 5¾"

MODEL

**AB**

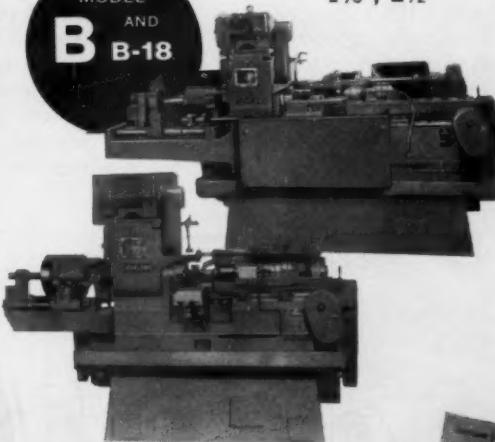


Dialmatics are the ultimate of single spindle design. On all sizes, infinitely variable turret tool feeds are set electronically by turning knobs. Feed monitor dial indicates exact rates. On the 1½" size, infinitely variable spindle speeds are also set by turning knobs, with rpm indicated on speed monitor. Dialmatics cut setup time to bare minimum!

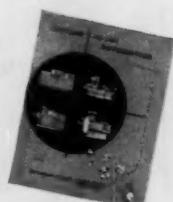
BAR AUTOMATICS

1½", 2½"

MODEL  
AND  
**B-18**



In place of a turret, Model B tooling is mounted on a flat milling slide and on two cross slides. Ideal for making studs or for shaft work involving multiple diameters, shoulders, etc. Model B-18 handles work up to 18" long.



Write for  
new general  
bulletin.

**AUTOMATIC MACHINE COMPANY**

4936 Beech Street • Cincinnati 12, Ohio



base and handle and steel plunger enable the clamp to withstand hard use and still operate as a precision tool. Specifications: over-all length, 11 1/4 inches; over-all height in forward locked position, 4 3/4 inches; base hole pattern, 2 1/4 inches wide and 2 3/4 inches long; spindle travel, 3 inches; center height of plunger, 2 1/4 inches; spindle hole, 5/8-inch thread; and weight, 5 1/2 pounds. Maker is Wespo Division, Vlier Engineering Corporation, Detroit, Mich.

Circle 581 on Readers' Service Card



Fig. 1. Lead checker developed by Michigan Tool Co. that permits optical setting of the sine bar

### Michigan Improved Sine-Line Lead Checkers for Helical, Spur, and Herringbone Gears

A Model 1218-A lead checker, Fig. 1, for external or internal helical gears that incorporates optical instrumentation, Fig. 2, for setting both the universal sine bar and an angular dividing head (not normally included in such equipment)

has been developed by the Michigan Tool Co., Detroit, Mich. This checker is not dependent on the operator's sense of touch because all settings are made by visual means. Angular settings can be made which are accurate within

0.001 degree without the use of gage-blocks. With new components incorporated in this lead checker, it is possible to do conventional continuous checking, or increment checking through use of the scale on the tailstock. Leads of external or internal helical, spur, and herringbone gears and worms can be checked from zero

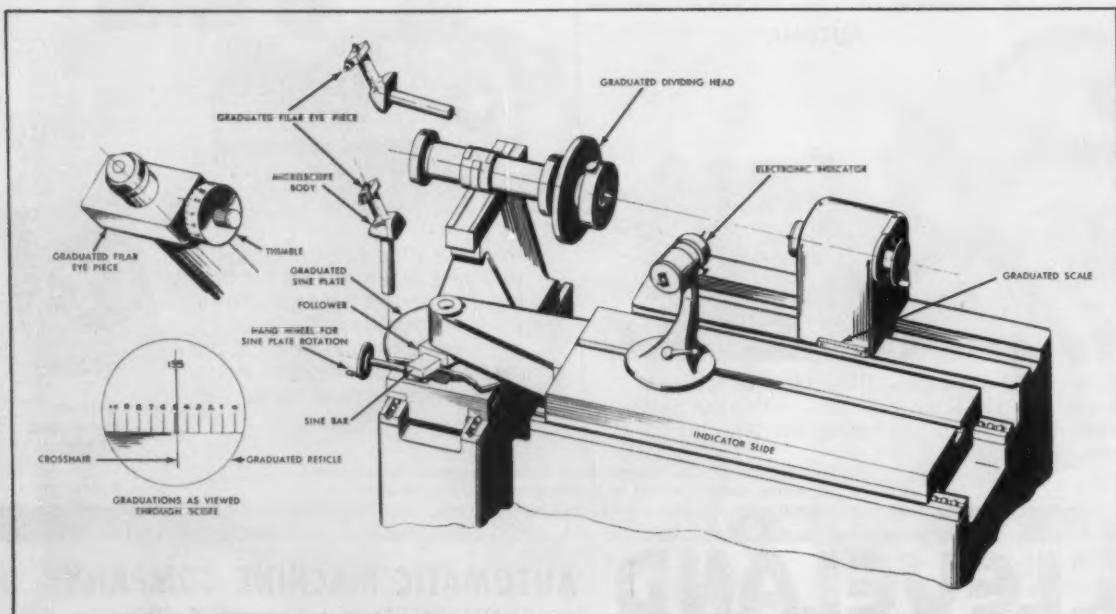


Fig. 2. Reticles and optical systems of sine plate and dividing head of gear checker shown in Fig. 1

Improved reliability • Greater capacity • No increase in price

## NEW DIRECTIONAL VALVE DESIGNS

WITH



Q-E-L\*

SOLENOIDS



New Q-E-L\* solenoids assure quiet, cool operation plus shock-free performance through superior cushioning.



Four to five times more cycle life than previously obtainable with ordinary air-cooled solenoids.



Capacity increased from 50 to 500% on new designs.



All models suitable for pressures to 3000 psi.



Complete range of sizes available for maximum flows to 440 gpm.



MODEL DG5S4 solenoid-controlled, pilot-operated valve is rated at 30 gpm (with nominal pressure drop) with a maximum capacity of 80 gpm without malfunction, depending on circuit conditions and valve type. Standard subplates are available with  $\frac{3}{4}$ -in. and 1-in. pipe thread connections. SAE straight thread port connections can also be provided. Write for Catalog 5001-C.

MODEL DG4S4 is rated at 8 gpm (with nominal pressure drop) with a maximum allowable capacity of 12 gpm without malfunction. Maximum recommended operating pressure is 3000 psi. Standard subplates are available with  $\frac{3}{8}$  in. or  $\frac{1}{2}$  in. pipe thread ports. SAE straight thread port connections can also be provided.

\* Q-E-L designates Quiet Extended Life solenoid—a Vickers exclusive.

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

ADMINISTRATIVE and ENGINEERING CENTER  
Department 1403 • Detroit 32, Michigan

8596

to infinity. Tooth spacing can be checked with the dividing head.

A chart recorder is integrally mounted in the headstock of the machine so that permanent records can be made of tests. A transistorized amplifier drives the recorder pen or a large-scale electronic meter graduated in ten-thousandths of an inch. The amplifier is designed with plug-in modular units for quick field maintenance.

Checking accuracy is high be-

cause the electronic indicator applies a load of less than 10 grams and has instantaneous response at high frequency. Leads of internal gears are checked with an angular offset stylus on the indicator. The indicator table can be operated from either the front or the rear of the checking machine. Reticles of the optical systems, Fig. 2, are graduated so that ten equal divisions cover 1 degree on the sine plate or dividing-head scale. The

thimbles have 100 graduations equal to one division on the reticles. Angles can thus be set to the nearest 0.001 degree with either optical system. The reading shown is 135.491 degrees. Gears with pitch diameters up to 18 inches can be checked with repeatable accuracy of 0.0001 inch in either laboratory or production use. Maximum distance between centers is 24 inches.

Circle 582 on Readers' Service Card

### Ther-Monic Heating Unit for Soldering Operations

Assurance of perfectly soldered joints in containers for perishable materials, including foods, has been made possible by the use of a Ther-Monic unit and a specially designed fixture brought out by the Induction Heating Corporation, Brooklyn, N. Y. A solder ring controls the exact amount of solder used, and the proper application of induction heat prevents any flaw in the hardening of the solder. The machine consists of a 1 1/2-kw generator and a two-place coil attached to a single fixture to facilitate mounting and storing. The solder ring is placed on the assem-

bly after it has been located in the fixture. This device prevents the use of too much or too little solder and eliminates waste. The two-place coil makes it possible for an unskilled operator to solder the spouts to the covers of the containers at the rate of 240 units per hour.

Circle 583 on Readers' Service Card

### Glennite Rotary Ultrasonic Welder

A rotary tip, ultrasonic foil welder designed for use in the packaging and electrical industries has been announced by the Vibro-Ceramics Division, Gulton Industries, Inc., Metuchen, N. J. Operating on the principle of ultrason-

ics—high-frequency sound waves—this newest addition to the manufacturer's Glennite ultrasonic line will weld metals such as aluminum foil, where surface oxidation of welding heat presents a deterrent to standard welders. It will also weld metals with high electrical conductivity, such as copper. Materials as thin as 0.00025 inch and up to 0.006 inch can be effectively and quickly welded through high-frequency sound alone.

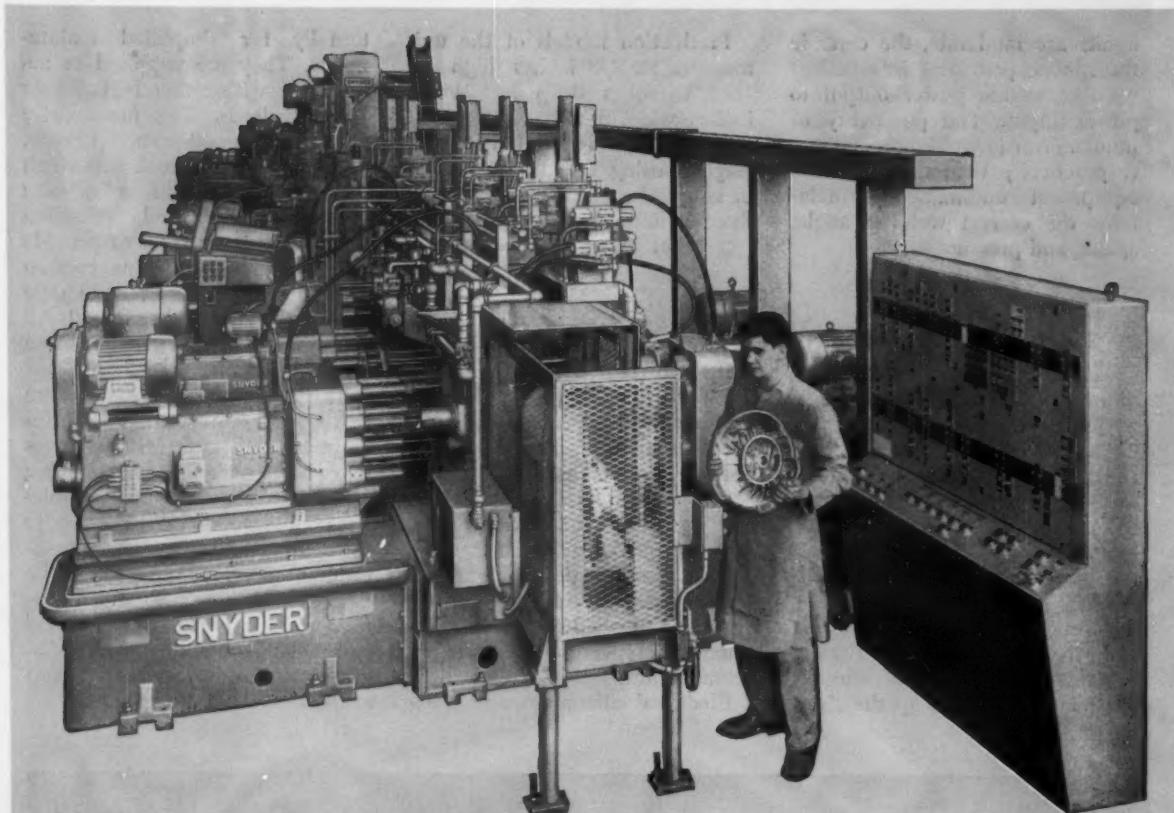
This rotary welder is especially suited for continuous welds on flat or semicircular sheets and is particularly advantageous to users who must avoid heat during the welding process. Operating costs are said to be low. Power require-



Ther-Monic heating unit adaptable to wide range of brazing, soldering, and annealing operations



Rotary tip, ultrasonic foil welder announced by the Vibro-Ceramics Division, Gulton Industries, Inc.



**DIFFERENT SIZED PARTS INTERMIXED AT RANDOM  
ARE PROCESSED AUTOMATICALLY ON SNYDER SPECIAL  
56-STATION TRANSFER**

Here's another big Snyder special "building-block" transfer with a bit of extra versatility.

Specifications called for one sequence of operations on a big aluminum transmission cover case for domestic use and a different sequence on a smaller cover for export.

Schedules set a production rate of about four domestic units to one export unit but, for production convenience, the machine had to accept these parts intermixed at random and run them through automatically.

So, Snyder Engineering designed a "collar" which bolts to the smaller piece, bringing it up to locating and clamping dimensions of the larger piece. Lugs on the collar and workpiece control appropriate switches which by-pass certain operations. Parts are automatically positioned in process.

Operations include drilling, reaming, boring, tapping, chamfering, spotfacing, center holing, end

milling, probing, air gaging, pressing in rectangular plug, pressing in bushing and a couple of washing operations.

Production is 150 parts an hour at 100% efficiency. Any of the 20 segments can easily be converted for comparable operations on other parts and the number of segments can be increased or reduced at any time. Your inquiries are invited.

**SNYDER**  
**CORPORATION**

*(Formerly Snyder Tool & Engineering Company)*

**3400 E. LAFAYETTE—DETROIT 7, MICHIGAN**

**Phone: LO 7-0123**

ments are moderate, the ceramic transducers providing an excellent ratio of usable power output to power input. The possibility of human error in welding technique is practically eliminated, as the equipment automatically maintains the correct welding angle, speed, and pressure setting.

Production models of the unit measure 23 3/8 inches high by 15 1/4 inches deep by 21 3/4 inches wide. Welding horn and generator are integrated into a single housing, but the system can be adapted to fit any existing production lines or job requirement.

Circle 584 on Readers' Service Card

### Monarch Heavy-Duty Dyna-Shift Lathe

The Monarch Machine Tool Co., Sidney, Ohio, has introduced a heavy-duty Series 91 Dyna-Shift lathe which has the weight and power for metal removal limited only by the tool and the characteristics of the work-piece. A major feature of this machine, Fig. 1, is the exclusive Dyna-Shift headstock. With it, the operator works in terms of surface cutting speed and the machine automatically calculates the correct revolutions per minute and sets up the shift.

Only two dials need be set—one for work diameter, the other for desired surface speed. Power shifting from one speed to another is quick and effortless.

Thirty-six speeds are available, ranging in geometrical progression from 6 to 750 rpm. Final work drive is through powerful helical gears. Free spindle and spindle jog are accomplished quickly. Both clutch and brake are hydraulically actuated and self-adjusting.

Electrical units are mounted ex-

ternally for simplified maintenance. They are supplied in accordance with either NMTBA or JIC standards. The main drive motor is in the 40- to 60-hp range. Drive to the headstock is through multiple V-belts. All four bedways are flame hardened, precision ground, and designed to provide chutes which lead chips into an open pan at the rear. Automatic lubrication is used throughout. All gears are hardened and precision finished.

The gear train and gear-box are totally enclosed. A total of forty-eight thread and feed changes may be secured. A time-saving feature is the four-way, variable-speed, hydraulic power traverse to the carriage and cross-slide. Longitudinal and cross traverse can be engaged separately or simultaneously. The apron handwheel and cross-feed dial automatically disengage during traverse and pickup at the same spot after traverse.



Fig. 1. Heavy-duty Dyna-Shift lathe introduced by the Monarch Tool Co.

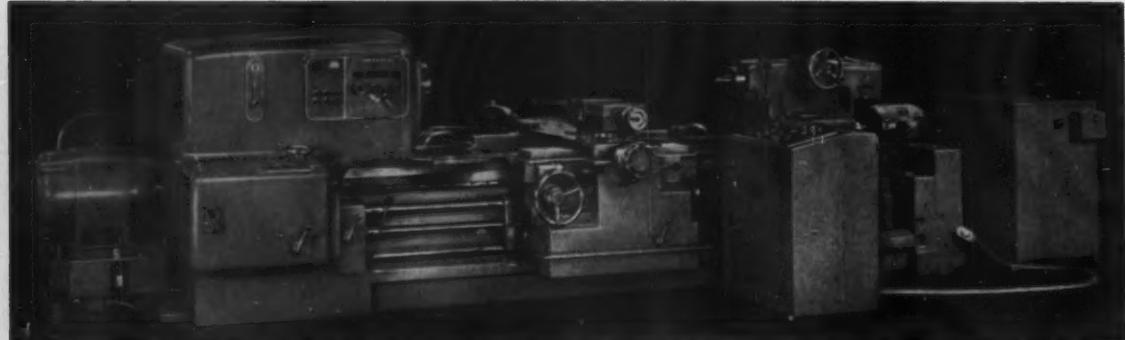
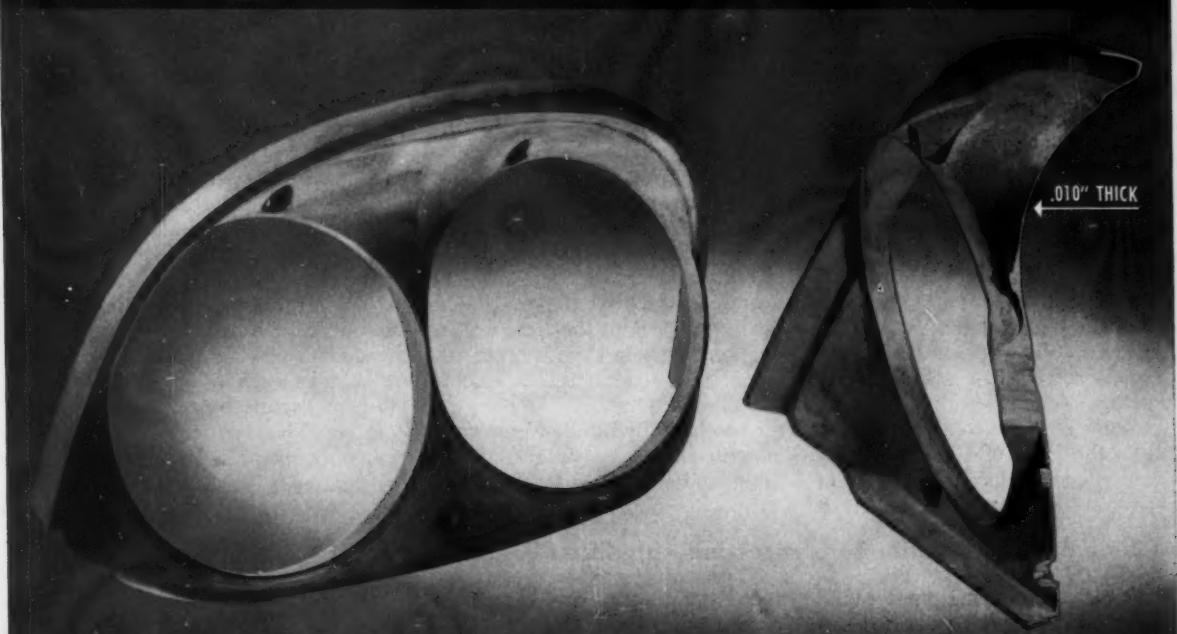


Fig. 2. Monarch Dyna-Shift lathe equipped with Electro-Gage Tracer

IT'S **LIGHTER** THAN YOU THINK!



**SMOOTH-FLOWING DESIGN ... BRIGHT, LASTING FINISH  
RIGID ... DURABLE ... ECONOMICAL**

**...WHEN DIE CAST with**



**ZAMAK**

Airfoil sculptured styling of today's automobiles demands parts designed to complement flowing body and fender lines.

ONLY ZINC DIE CASTING ALLOYS can produce the intricate shapes and smooth, compound-curve surfaces—as in this headlight door—with the necessary thin-wall sections, strength, rigidity and production economy.

Improved techniques in chromium plating on

Zamak die cast parts provide a more permanent bright finish with greater resistance to corrosion than ever before.

The weight-saving advantages of ZINC die castings, with built-in qualities of durability and economy, point up the important reasons why Zamak has become the leading material for the production of die cast parts in today's automobiles.

HORSE HEAD® SPECIAL ZINC AND HORSE HEAD ZAMAK ARE PRODUCED BY  
**THE NEW JERSEY ZINC COMPANY**

DEVELOPERS OF THE ONLY STANDARD ZINC DIE CASTING ALLOYS IN USE TODAY

160 Front Street • New York 38, N. Y.



This Series 91 machine is offered in three models—4025, 4025-31, and 4025-36. A wide assortment of accessory equipment is available, including the Monarch Air-Gage Tracer.

A 360-degree, two-axis, electro-hydraulic tracer system, designated the Monarch Electro-Gage Tracer, is shown on a Series 91 heavy-duty Dyna-Shift lathe in Fig. 2. This lathe is recommended for machining work-pieces of any kind having complex contours.

The tracer head utilizes a variable reactance device which sends signals to an electronic control console for interpretation and amplification. Modulated signals from the console provide electro-hydraulic servo-valve control for regulating oil flow to the hydraulic motors. The electronic equipment is in the form of fully transistorized plug-in modules for ease of

maintenance. The console, which is on casters, may be located convenient to the operator, giving him a complete control center.

Carriage motion is powered by a hydraulic motor which is connected through a feed and traverse gear-box to the lead-screw. The actuator consists of an electro-hydraulic valve mounted on the hydraulic motor with tachometer feedback. This valve controls the oil flow through the motor in accordance with the electronic signals from the console. Infinitely variable feed rates are obtained by potentiometer control through the feed gearing in the gear-box. The same motor, operating through gearing, provides the traverse. Selection between the feed and traverse gear trains is by electric clutches.

Another hydraulic motor is mounted on the rear of the carriage and connected through feed

and traverse gearing to the cross-feed screw. Operation is the same as that for the carriage motor previously described. Since the tracer functions on a constant tangential feed-rate basis, feed rate along the template profile is constant regardless of profile shape. To protect the operator, the longitudinal- and cross-feed screw handwheels are disconnected automatically when the control console is energized.

Hydraulic power is provided by a tank unit separately located at the right end of the machine. Lathes equipped with the Electro-Gage Tracer may be used for conventional operations, as the hydraulic motors for driving the lead-screw and the cross-feed screw are disconnectable. In such a case, the regular carriage power rapid traverse of the machine becomes operative. This new tracing system can only be applied on new lathes.

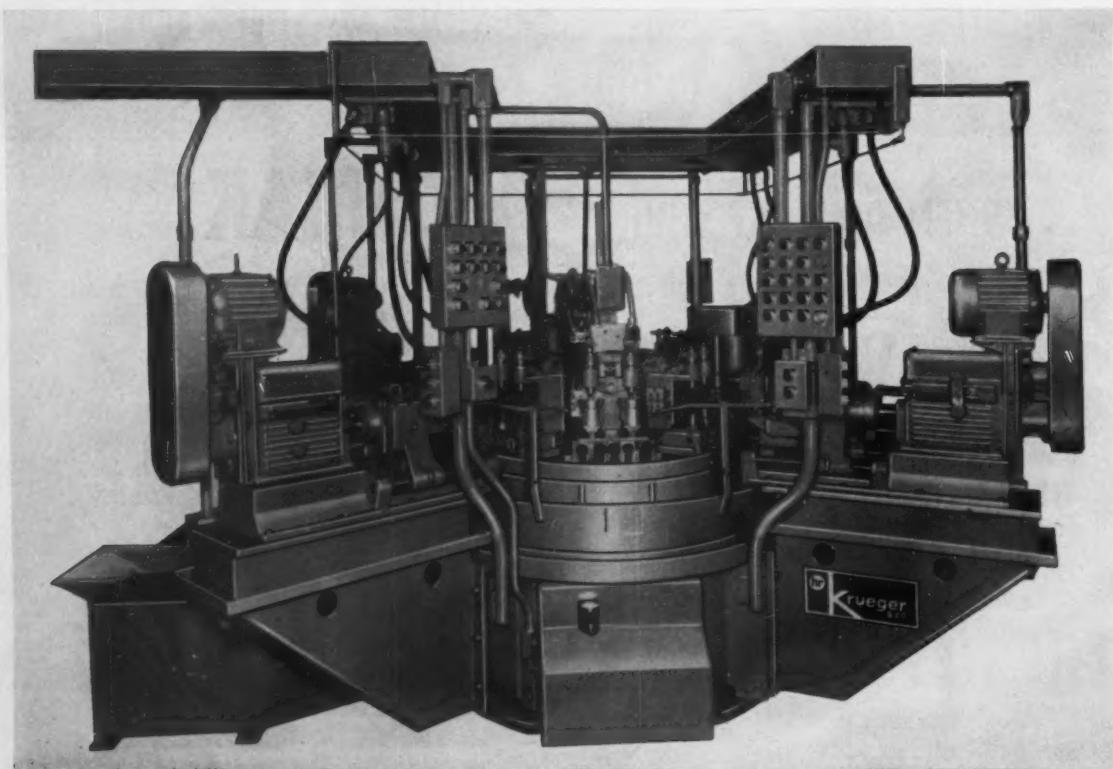
Circle 585 on Readers' Service Card

### Radial Index Machine for Processing Aluminum Pistons

A six-station, horizontal radial index machine that performs six-

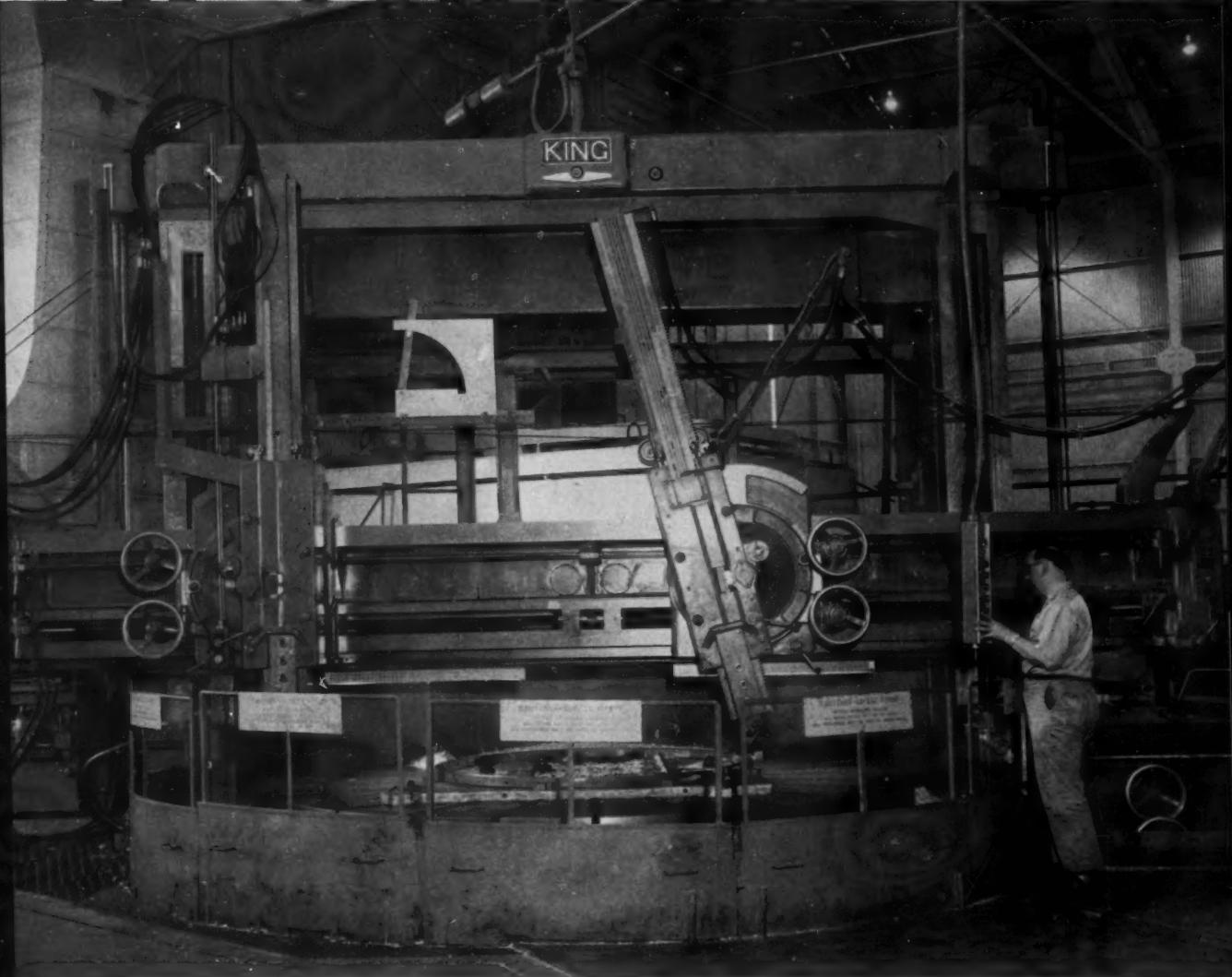
teen operations on aluminum automotive pistons during a thir-

teen-second cycle has been announced by H. R. Krueger & Co., Detroit, Mich. The machine handles two pistons simultaneously—



Krueger six-station radial index machine for processing aluminum pistons

# AT CONVAIR - SAN DIEGO



Convair's Plant No. 1 Tooling Department uses this specially designed 168" KING® to shape drop hammer dies, plastic patterns used for production mock-ups,

and plastic tools. They report, "Production of such tooling in sizes and tolerances required was not possible with previously available machines."

Versatility is just *one* virtue of this  
big "customized" **KING**  
It's Fast, Accurate and Dependable, too!

**KING** *Vertical Boring and Turning Machines*

**ELMES** Hydraulic Presses and Equipment

American Steel Foundries / ELMES-KING Division, 1162 Tennessee Avenue, Cincinnati 29, Ohio

drilling, milling, chamfering, and slit-sawing in one operation.

Parts loaded at the first station go to the second and third stations where four 3/32-inch diameter holes are drilled through. At the fourth station two 5/32-inch diameter holes are through-drilled and two 0.344-inch diameter holes are drilled and chamfered. Four oil-

feed pockets are milled in each piston at the fifth station. The parts are then advanced to the sixth station where a slit-sawing operation produces two 0.0625-inch expansion slots in the piston walls, thus completing the cycle.

This new Krueger machine features a 40-inch diameter automatic Geneva motion type indexing

table, and is equipped with one flat saddle type, and four self-contained quill type, hydraulic units. The table indexing time is said to be 1.5 seconds. Fixture clamping and unclamping is completely automatic. The machine will accommodate a number of different size pistons.

Circle 586 on Readers' Service Card

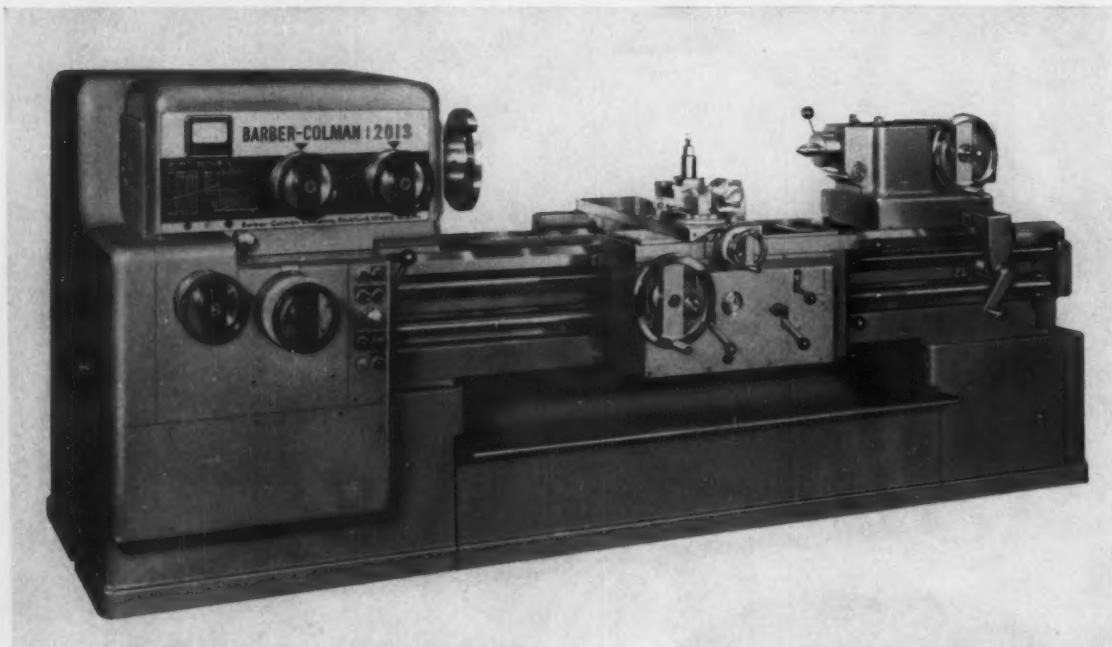


Fig. 1. Precision, heavy-duty Barber-Colman No. 2013 lathe that combines many qualities of a roughing lathe with the versatility, controls, and precision of a toolroom lathe

### Barber-Colman Tracer-Controlled Precision Lathe

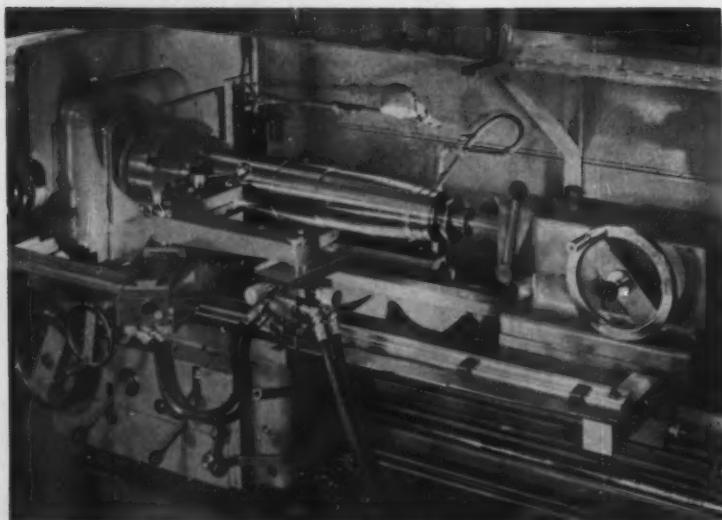
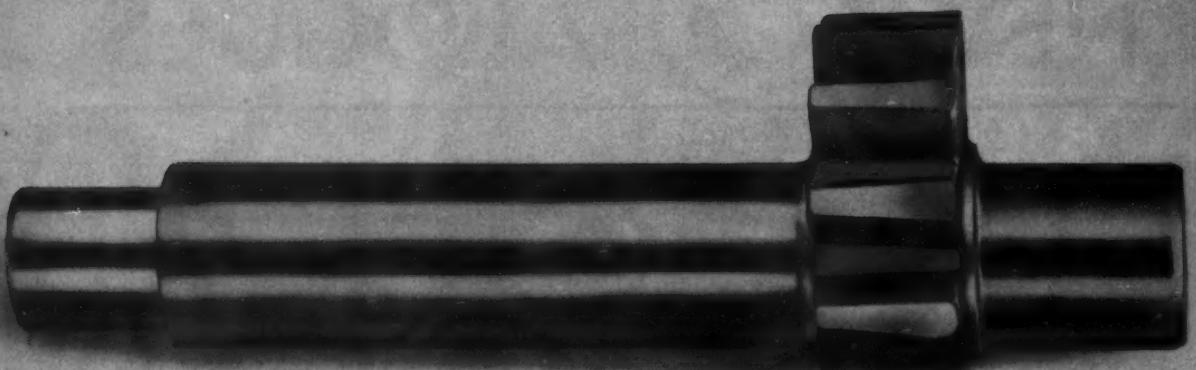


Fig. 2. Barber-Colman No. 2013T tracer-controlled lathe available in 20- and 25-inch capacities

A precision, heavy-duty lathe with spindle speeds up to 2000 rpm and equipped with hydraulic tracer was demonstrated by the Barber-Colman Co., of Rockford, Ill., at the Chicago Exposition. This geared head No. 2013T lathe unites many of the qualities of a roughing lathe with all of the versatility, controls, and precision of a toolroom lathe. It combines sixty-six thread and feed changes, the feeds ranging from 0.0015 to 0.091 ipr of the spindle. Automatic threading stops and other toolroom features are incorporated in this machine, which is capable of applying 40 hp through the spindle. An indication of the machine's rigidity is the weight (500 pounds) of the tailstock.

To show how it may be utilized  
*(Continued on page 200)*



THE Gleason Revacycle® method and its machine present the fastest way known for cutting precise straight bevel gears.

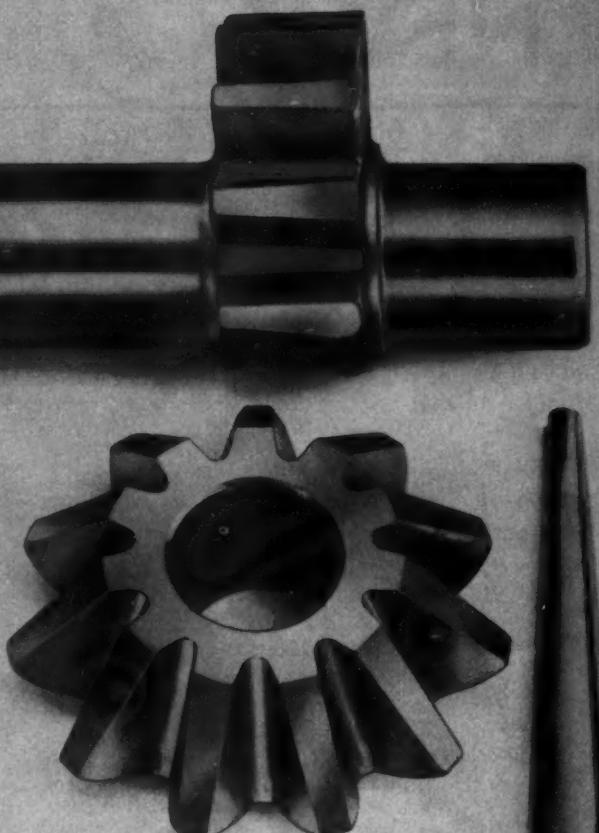
The Revacycle cutter holds roughing, semifinishing, and finishing blades. One revolution of the cutter completes a tooth space in 2.5 seconds. In fact, on smaller pieces, you can complete as many as four tooth spaces with a single cycle . . . that's less than  $\frac{1}{2}$  second per tooth!

This completely automatic Gleason machine can frequently replace a tandem of roughing and finishing machines . . . thereby saving considerably on capital investment.

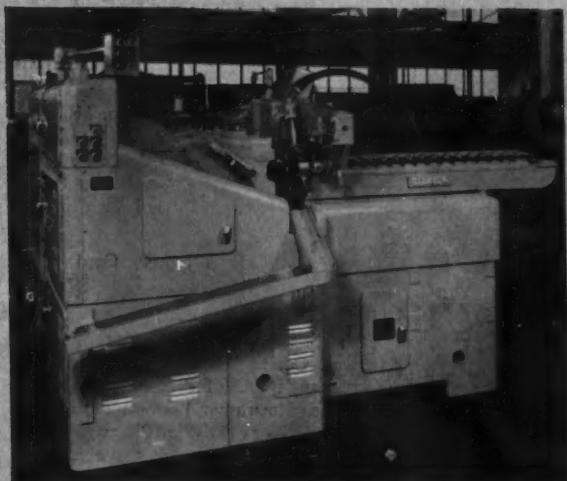
Best of all, to get this speed and economy you need sacrifice nothing in accuracy. The Revacycle method produces localized tooth bearing which permits any practical assembly tolerances while avoiding load concentration at the ends of the teeth. And, you get exact reproduction piece after piece, day after day.

The machine accepts a wide range of work: diameters up to 10" at a 5 to 1 ratio and face widths up to 1.25".

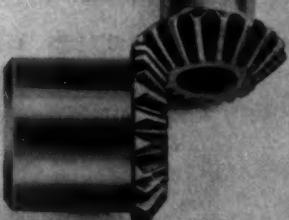
For complete background and data, write for a bulletin. Gleason engineers will help you with details on any specific applications.



## How to cut a bevel gear tooth in 2.5 seconds



7.2 SECONDS is all it takes to dechuck a finished piece and chuck in a new blank with the automatic loading attachment on the 109 Revacycle Machine.



**GLEASON WORKS**

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

# NEW CATALOGUES

• Yours for the asking . . . use postcard inside back cover



#### Ductile Iron

Brillion Iron Works Inc., Brillion, Wis. Bulletin 131-B giving detailed information on the features of ductile iron, along with Brillion's facilities, manufacturing and quality control, for the processing of this highly specialized metal.

Circle Item 501 on Inquiry Card



#### Grinding and Polishing Machines

Acme Mfg. Co., Detroit, Mich. Catalogue No. AM-6 describing a line of flat-surface grinding and polishing machines for finishing and deburring parts such as sheets, bars, strips, coils, blanks, printed circuit boards, stampings, forgings, etc.

Circle Item 502 on Inquiry Card



#### Lead-Screw Tapper

Thriftmaster Products Corporation, Lancaster, Pa. Bulletin on their "Lead Screw" tapper, which taps all sizes of holes with one lead-screw. It requires only the replacement of one small gear, in minutes, to change the tapping pitch.

Circle Item 503 on Inquiry Card



#### Machine Tools

Rockwell Mfg. Co., Walker-Turner Division, Pittsburgh, Pa. Catalogue on their line of light-heavyweight machine tools and accessories. Drill presses, grinders, cutoff machines, band saws, and belt and disc surfacers are covered.

Circle Item 504 on Inquiry Card



#### Lathes

Cone Automatic Machine Co., Inc., Pilot Division, Windsor, Vt. Brochure covering the several new Conomatic Pilot lathes, Model KU. Among its features are extreme sensitivity of tracing system and constant control over tool movement.

Circle Item 505 on Inquiry Card



#### Ultrasonic Gages

Branson Instruments, Inc., Stamford, Conn. Catalogue featuring Vidigage ultrasonic gages for nondestructive testing from one side, thickness measurements, and detection of laminar flaws. Applications, accessories, and specifications are given.

Circle Item 506 on Inquiry Card



#### Cleaning Machines

Turco Products Inc., Wilmington, Calif. Bulletin presenting propeller type Turbulator cleaning machines with four-flow action. Available in fourteen sizes, they are equipped for washing, degreasing, decarbonizing, and descaling.

Circle Item 507 on Inquiry Card



#### Punching and Notching Machine

Wales Strippit Inc., Akron, N. Y. Catalogue 30S on the Strippit Super 30 Fabricator, a multiple-purpose, single-station sheet metalworking machine. Micrometric gaging, swing-shift punch-holders, and drop-in die buttons are described.

Circle Item 508 on Inquiry Card



#### Cutoff Tools

Somma Tool Co., Waterbury, Conn. Supplement to Catalogue No. 58, on additions to their line of form tools and blanks for automatic screw machines. Included are solid-carbide, straight-blade, and T-5 high-cobalt steel cutoff tools.

Circle Item 509 on Inquiry Card



#### Turnover Cradles

La Deau Mfg. Co., Los Angeles, Calif. Circular presenting information on their new portable Turnover Cradles for handling coiled materials, which automatically rotate and palletize coils of 3000 to 40,000 pounds in less than a minute.

Circle Item 510 on Inquiry Card



#### Unitized Tooling

Tool Products Corporation, North Tonawanda, N. Y. Catalogue No. MO-6 on Series "RD" (regular duty) unitized tooling for the metal-fabricating industry. This line of perforating units is for mild steel up to 1/8 inch in thickness.

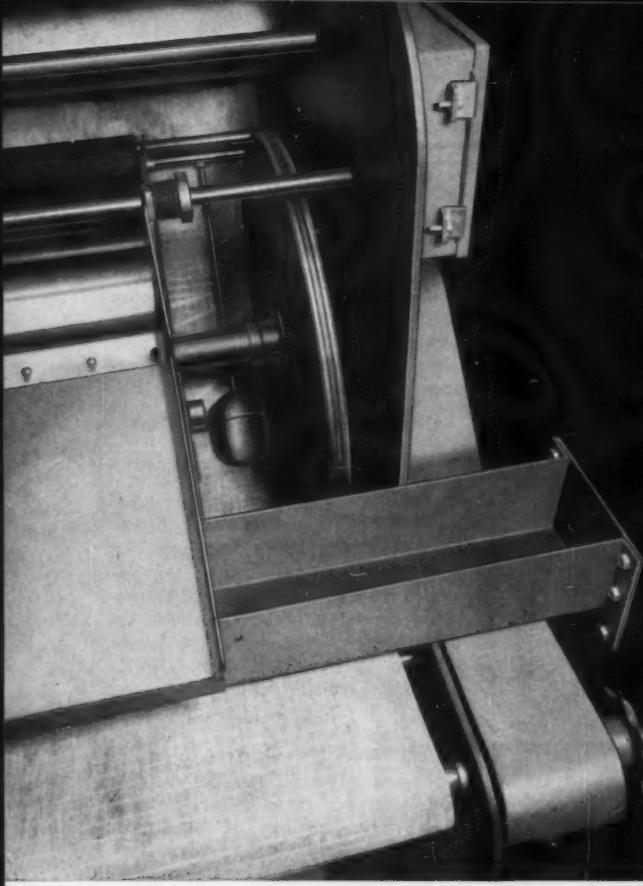
Circle Item 511 on Inquiry Card



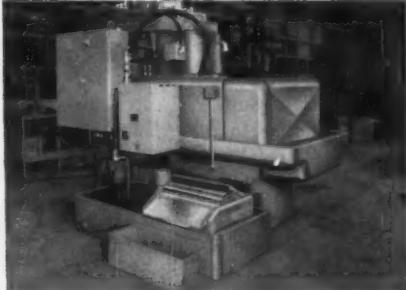
#### Gun Drills

High Standard Mfg. Corporation, Hamden, Conn. Brochure describing the company's line of deep-hole drills against an illustrative background of the United States Missile Program—its research, space, test, and special-purpose missiles.

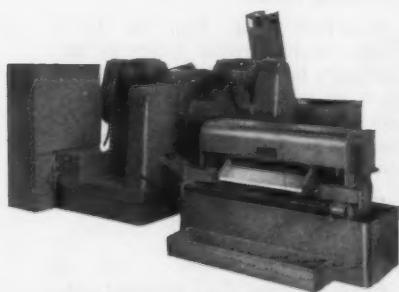
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HERE'S WHY  
**BARNESDRIL**  
COOLANT CLEANING  
EQUIPMENT DOES  
A BETTER JOB...  
AND AT  
**LESS COST**



Note how this Barnesdril Magnetic Separator is mounted in the coolant tank of a rotary surface grinder.



Compact installation of a Barnesdril Kleenall Combination Filter and Separator on a double disc grinder.

For Grinding, Honing, Gear-Cutting . . . or any similar operation requiring an abundant supply of clean, grit-free coolant . . . your best bet is a Barnesdril Unit for *automatic* sludge removal. Here's why...

**Compact Design**

requires less floor space . . . often permits installation of Barnesdril Units in the machines' outside coolant tank.

**No Jets, Tubes, or Screens to Clog**

and impair cleaning efficiency. And, the Barnesdril gentle action system prevents particles from being forced through the filter.

**Low-Cost Filter Fabrics**

actually increase in efficiency as swarf builds up on the filter media, which accounts for the low consumption of fabric on Barnesdril Filters. Our laboratory technicians will select the correct filter fabric for your job application.

**Powerful Magnetic Field**

For every 5 g.p.m. coolant capacity, Barnesdril Separators pack eight pounds of permanent Alnico magnets — the strongest magnetic attraction possible.

**Three Models in a Wide Range of Capacities**

Barnesdril Kleenall Filters, Combination Magnetic and Fabric Filters, and Magnetic Separators range in capacity from 1½ to 120 gallons per minute. Specially engineered Central Systems are also available!

**WRITE FOR KLEENALL BULLETIN  
100 TODAY!**



**BARNESDRIL**

FILTRATION UNITS



Honing Machines / Production Units / Filtration Units / Drilling Machines

**BARNES DRILL CO.**

820 Chestnut Street • Rockford, Illinois  
DETROIT OFFICE — 13121 Puritan Avenue

## catalogues . . . bulletins . . . manuals

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### Electric Heaters

General Electric Co., Schenectady, N. Y. Bulletin GEC-1005K listing data for G-E Calrod tubular, finned tubular, cartridge, strip, insertion, and vane heaters; forced and natural convection air heaters; and Form G and edgewound oven heaters.

Circle Item 513 on Inquiry Card



### Diamond-Impregnated Products

Fish-Schurman Corporation, New Rochelle, N. Y. Catalogue DG 395 describing the FS Steelset metal-bonded, diamond-impregnated products, including drills, wheels, blades, dressers, hones, and laps. Diagrams and specification charts are given.

Circle Item 514 on Inquiry Card



### Missile Hydraulic Components

Denison Engineering Division, American Brake Shoe Co., Columbus, Ohio. Bulletin 204 on missile hydraulic components, outlining the use of hydraulic pumps, motors, and controls in missile transporters, erectors, launchers, and testing systems.

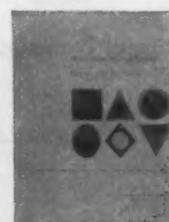
Circle Item 515 on Inquiry Card



### Gaging Instrumentation

Measurement Control Devices, Camden, N. J., subsidiary of Schaeftz Engineering. Catalogue No. G-100 presenting the systems and components available for continuous indicating and monitoring of minute changes in dimensions for control usages.

Circle Item 516 on Inquiry Card



### Abrasives Unit

S. S. White Industrial Division, New York City. Bulletin 6006, on their Abrasives units, provides information on improved cutting techniques, new applications, performance charts, cutting powders, and accessories for this cutting tool.

Circle Item 517 on Inquiry Card



### Press-Overload Detector

Wintress, Inc., New York City. Bulletin describing the Circuit Master Mark III press-overload detector, which provides automatic protection against die and press damage caused by "doubles," misfeed, buckling, thickness variations, and pile-ups.

Circle Item 518 on Inquiry Card



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### Hydraulic Cylinders

Sheffer Corporation, Cincinnati, Ohio. Bulletin No. 260 featuring information on the new, improved Sheffer C4H series 2000- to 3000-psi interchangeable hydraulic cylinders in bore sizes of 1 1/8 to 12 inches and seventeen mountings.

Circle Item 519 on Inquiry Card



### Circumferential Automation

National Acme Co., Cleveland, Ohio. Bulletin CA-60 featuring details of Acme-Gridley multiple-spindle bar and chucking automatics. Demonstrated are jobs showing normal tooling practices and difficult operations. To obtain copies, write on company letterhead to National Acme Co., 170 E. 131 St., Cleveland 8, Ohio.



### Slitting Shears and Flangers

Niagara Machine & Tool Works, Buffalo, N. Y. Bulletin 70G on Niagara's complete line of redesigned ring, circle, and slitting shears and flangers. Included are descriptions of power-operated shears and flangers for medium and heavy work.

Circle Item 521 on Inquiry Card



### Cutoff Machine

Salem-Brosius, Inc., Pittsburgh, Pa. Brochure on the Reactron torque-cutting bar-stock cutoff machine, which is built in three sizes for bar stock up to 1, 2, and 2 3/4 inches in diameter and cuts round, square, hexagon, and octagon shapes.

Circle Item 522 on Inquiry Card



### Oscillating Motors

Roto-Tork Mfg. Co., St. Clair Shores, Mich. Circular presenting the company's line of high-efficiency pneumatic or hydraulic oscillating motors with instant full torque. Featured are descriptions of the double- and single-vane models.

Circle Item 523 on Inquiry Card



### Socket-Head Cap-Screws

Standard Screw Co., Bellwood, Ill. Brochure providing the latest information on the new "1960 Series" Stan-screw socket-head cap-screws, plus dimensional data on the "1936 Series." Separate thread-length charts are also provided.

Circle Item 524 on Inquiry Card



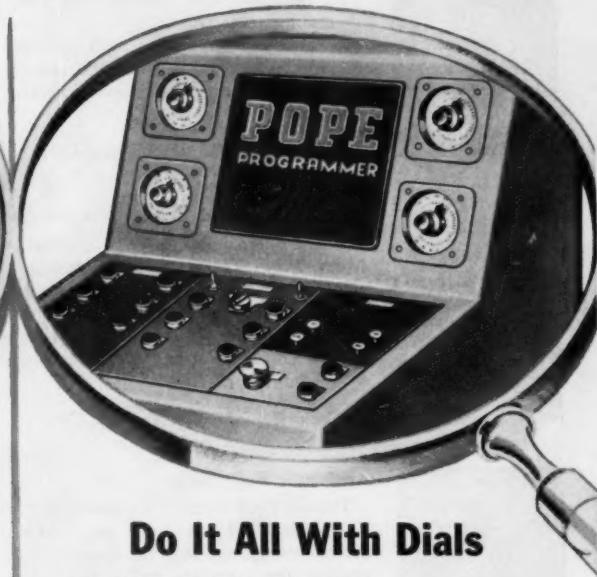
# YOU CAN INCREASE PROFIT AND PRODUCTION with this new **POPE 10-6** SUPER-PRECISION BORING MACHINE



## Two Heads Are Better Than One

and of course you can have more than one spindle in each head. The Pope Model 10-6 features *two precision boring heads\** operating completely independently of each other to provide simultaneous or alternate cycling movement of the heads. *This means increased production.*

\*The Pope Boring Head Spindles on this machine revolve within 20 Millionths.



## Do It All With Dials

Automatic cycles for boring operation sequences are programmed on these dials. The operator simply determines the sequence of operations and dials each one. You get continuous production of uniform parts in less time.

The Pope Electric Programmer gives you finger-tip fast control of infinitely variable speed, distance and operating sequence. You dial in the complete program with ease and speed that beats expensive numerical or tape control. Supreme accuracy is maintained for cycle after cycle.



No. 132  
For precision production at a profit  
look into this Pope Model 10-6.  
Write for Bulletin S-21.



# POPE®

POPE MACHINERY CORPORATION • 261 RIVER STREET • HAVERHILL, MASS.

ENGINEERS, DESIGNS AND BUILDS  
PRECISION ANTI-FRICTION BEARING SPINDLES  
FOR EVERY PURPOSE

Established 1920

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### High-Precision Parts Services

Enterprise Division, Michigan Tool Co., Detroit, Mich. Bulletin No. 100, describing research, development, testing, and manufacturing facilities for making high-precision parts and prototypes. Listed are equipment, capacities, and types of work.

Circle Item 525 on Inquiry Card



### Belt Grinders and Sheet Surfacing

Sales Service Mfg. Co., St. Paul, Minn. Form TM860 giving a description of Tri-Matic oscillating belt grinders, 12- through 48-inch sizes. Also included is the Tri-Matic oscillating sheet surfacer using abrasive-imregnated nylon.

Circle Item 526 on Inquiry Card



### Automatic Roll Feeds

Durant Tool Supply Co., Providence, R. I. Catalogue presenting details on the company's automatic roll feeds, including the complete range of sizes and capacities. Featured is a brief description of their Select-O-Matic roll-feed indexer.

Circle Item 527 on Inquiry Card



### Magnetic Coolant Separators

Barnes Drill Co., Rockford, Ill. Catalogue No. 300-D presenting the Barnesdril magnetic separators. Applications include grinders, honing machines, gear shavers, broaching machines, thread-rolling machines, milling machines, and deep-hole drills.

Circle Item 528 on Inquiry Card



### Spindle-Repair Service

Pope Machinery Corporation, Haverhill, Mass. Bulletin R-3 describing their facilities for repair and renewal of all makes and sizes of belt-driven, motorized, and high-cycle spindles for grinding, boring, drilling, and milling operations.

Circle Item 529 on Inquiry Card



### Speed Reducers

Link-Belt Co., Chicago, Ill. Book 2719 on their redesigned and expanded line of "balanced design" parallel shaft reducers in fifty-seven sizes, including twenty-three new sizes. Single-, double-, and triple-reduction units are available.

Circle Item 530 on Inquiry Card



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### Flame-Hardening Equipment

Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. Form ADC 704A on flame-hardening equipment, discussing the various problems of oxyacetylene flame hardening and showing how they can be solved with Airco equipment.

Circle Item 531 on Inquiry Card



### Lathe

Rivett Lathe & Grinder, Inc., Boston, Mass. Bulletin on Rivett 60 series precision speed lathe. Highlighted is the new "one motion control." Single lever starts lathe spindle, selects speed up to 4800 rpm, and changes speed during operation.

Circle Item 532 on Inquiry Card



### Industrial Models

Knight Models, Inc., Chicago, Ill. Folder covering their three-dimension scale models—multiple-purpose management tools for the improvement of manufacturing methods, process and material flow, industrial training, and maintenance.

Circle Item 533 on Inquiry Card



### Tank Units

Ruthman Machinery Co., Cincinnati, Ohio. Bulletin 61A briefly describing the company's Gusher tank units, which may be used as portable or auxiliary systems. Included in the bulletin are diagrams, as well as a specification chart.

Circle Item 534 on Inquiry Card



### Multiple Spindles

Gardner-Denver Co., Quincy, Ill. Catalogue offering a wide selection of multiple spindles for production nut-setting. Included in the description are power units meeting torque requirements of over 200 foot-pounds, plus the "Safe Torque" clutches.

Circle Item 535 on Inquiry Card



### Threading Tools

National Acme Co., Threading Tools Division, Cleveland, Ohio. Bulletin DT-60, on their complete line of threading tools. Included are Vers-O-Tool self-opening threading and hollow milling heads, and collapsible and solid adjustable taps.

Circle Item 536 on Inquiry Card





**For Your Power Drive • Design • Application or Replacement Maintenance**

There's a **T-J CYLINDER**  
That Can Assure Accurate Efficient Operation

Only T-J's complete line can assure you a cylinder of either air or hydraulic application—with practically limitless design specifications for bore, stroke, pressure range and even delivery requirement. From the time-tested,

standard tie-rod air and hydraulic, to the exclusive T-J Spacemaker, and including the recently introduced Squair Head, T-J cylinders give you more features for efficient, long-lasting operation. Write today!

*Plus*

**THE ONLY  
COMPLETE  
ENGINEERING  
CATALOG  
LINE, TOO!**



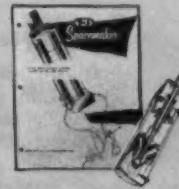
H-47 for  
standard tie-rod  
hydraulic cylinders.



SQ-1058-4  
for the T-J  
Squair Head  
cylinder.



No. 54 for  
standard tie-rod  
air cylinders.



SM-58-3 for  
the incomparable  
Spacemaker  
cylinder.



HSM5-58-4  
for the High-  
Pressure Hydraulic  
Spacemaker cylinder.

**THE TOMKINS-JOHNSON CO. JACKSON, MICH.**  
CYLINDERS • MILLING CUTTERS • RIVETERS and CLINCHERS

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### Cadillac Gages

Cadillac Gage Co., Detroit, Mich. Catalogue on the company's complete line of gages, including specifications, sizes and prices of their thread plug and ring gages, cylindrical plug and ring gages, and pipe thread plug and ring gages.

Circle Item 537 on Inquiry Card



### Chucks

Hardinge Brothers, Inc., Elmira, N. Y. Bulletin 8D, presenting the Hardinge-Sjogren line of speed collet chucks for toolroom lathes, engine lathes, and grinders. Included in the description are the regular, step chuck, and lever types.

Circle Item 543 on Inquiry Card

### Hydraulic Cylinders

Pathon Mfg. Co., Cincinnati, Ohio. Supplement to Bulletin 22A, giving a description of the company's Series 3H 3000-psi hydraulic cylinders. The line covers a wide range of sizes and introduces a new Clevis-mounted model with accessories.

Circle Item 538 on Inquiry Card



### Drilling Machine

Heald Machine Co., Worcester, Mass. Circular giving a description of the Model 20-48 Headrill, a numerically controlled drilling machine which performs—in addition to drilling—reaming, tapping, spot-facing, and light-boring operations.

Circle Item 544 on Inquiry Card

### Automatic Assembly Machine

Ferguson Machine Corporation, St. Louis, Mo. Catalogue No. 602 on a standard rotary transfer machine including parts-placing motions at the working area on the dial. Data is given for standard cam-actuated work-station mechanisms.

Circle Item 539 on Inquiry Card



### Boring and Milling Machines

DeVlieg Machine Co., Royal Oak, Mich. Brochure on the company's developments in basic machines and accessories for precision boring and milling, revealed at the National Machine Tool Show. Features of the Spriomatic Jigmil machines are included.

Circle Item 545 on Inquiry Card

### Metal-Cutting Products

Firth Sterling, Inc., Pittsburgh, Pa. Catalogue TTI-60 giving prices, specifications, and general information on all Firthite tips, tools, tool-holders, and inserts. Grade NTA—A new general-purpose steel-cutting grade—is discussed.

Circle Item 540 on Inquiry Card



### Pumps, Valves, and Motors

Hydrexco Division, New York Air Brake Co., Kalamazoo, Mich. Bulletin No. 10-001 on Hydrexco gear pumps, control valves, and motors and their application on mobile equipment and production machinery. Included is the Hollow-Plunger control valve.

Circle Item 546 on Inquiry Card

### Cutting Machine

Allison-Campbell Division, American Chain & Cable Co., Inc., Bridgeport, Conn. Brochure featuring information on the company's new Model 2-A Sever-All dry abrasive cutting machine. Included are descriptions of a variety of work-holders.

Circle Item 541 on Inquiry Card



### Shipping Mounting Systems

Lord Mfg. Co., Erie, Pa. Bulletin No. 716 describing how protection against shipping/handling damage can be achieved with Lord elastomeric mounting systems. Independent drop and vibration test results are given, with charts and graphs.

Circle Item 547 on Inquiry Card

### Turret Lathes

Gisholt Machine Co., Madison, Wis. Form 1224 providing information on the newly designed Gisholt Masterline AR turret lathe. The machine performs equally well on either chucking or bar work, with change-over requiring less than one hour.

Circle Item 542 on Inquiry Card



### Numerical Control System

Diehl Mfg. Co., Somerville, N. J. Brochure describing the Singer numerical control system, advantages of which include production accuracy of up to plus or minus 0.0002 on a 40-inch work-table, and flexibility and economy of operation.

Circle Item 548 on Inquiry Card

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## Building-Block Machine Tools

La Salle Machine Tool, Inc., Warren, Mich. Catalogue giving information on building-block design, standardized components, and machine classifications. A side, back, and full view of a completed machine constructed of building blocks is shown.

Circle Item 549 on Inquiry Card



## Flexible Shafting

S. S. White Industrial Division, New York City. Revised fourth edition of the company's "Flexible Shaft Handbook," now available at no cost to design engineers and potential users of flexible shafts. Charts, tables, and drawings are provided.

Circle Item 555 on Inquiry Card



## Automatic Lubrication

Bijur Lubricating Corporation, Rochelle Park, N. J. Reissued bulletin, entitled "The A.B.C. of Modern Lubrication," describing the three basic elements of automatic lubrication—lubricators, distribution systems, and "Meter-Units."

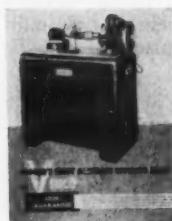
Circle Item 550 on Inquiry Card



## Honing

Barnes Drill Co., Rockford, Ill. Catalogue No. 200 describing internal, external, and straight-line honing. The development of honing and the honing process are explained. Charts list spindle speeds and coolants for various operations.

Circle Item 556 on Inquiry Card



## Dividing Heads

Vinco Corporation, Detroit, Mich. Brochure on the applications, accuracy, operation, and floor space of three models of the Vinco optical master inspection dividing head. A condensed content of the Vinco angular-spacing book is included.

Circle Item 551 on Inquiry Card



## Drilling Machine

Burg Tool Mfg. Co., Inc., Gardena, Calif. Catalogue sheet on the Burgmaster Model 25AH automatic hydraulic, six-spindle turret drilling machine with 1/4-inch capacity in steel, preselective spindle speeds, and infinitely variable feeds.

Circle Item 557 on Inquiry Card



## Chipless Machining Process

Michigan Tool Co., Detroit, Mich. Bulletin RF-60 on the Roto-Flo process of chipless machining for cold-forming splines, serrations, grooves, threads, and similar forms. Illustrated are ways of obtaining increased output, material savings, etc.

Circle Item 552 on Inquiry Card



## Drive Equipment

General Electric Co., Schenectady, N. Y. Bulletin GEA-7147 on direct-current, adjustable-voltage drive equipment for planers, featuring Kinematic direct-current drive motors with low armature inertia and high transient commutating ability.

Circle Item 558 on Inquiry Card



## Drill-Jig Bushings

American Drill Bushing Co., Los Angeles, Calif. Catalogue containing a selection of the company's drill-jig bushings. New products include Unalok bushing liners, Delt-A-Liners, and the Multi-Jig, locating jig, and round-clamp accessories.

Circle Item 553 on Inquiry Card



## Plug Gages

Van Keuren Co., Watertown, Mass. Buyers catalogue and price list (Section P) describing their cylindrical- and thread-ring plug gages, including Taperlock and Trilock types. Specifications for the gages, handles, and bushings are given.

Circle Item 559 on Inquiry Card



## Tool-Holders

Wesson Co., Ferndale, Mich. Bulletin No. C-660 featuring the eighteen standard cartridge type tool-holders in the Wesson insert-cartridge system for assembling a variety of single or combination boring, facing, and recessing tools.

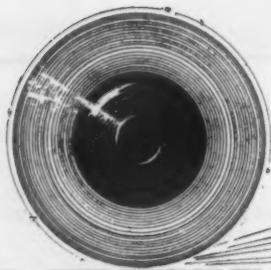
Circle Item 554 on Inquiry Card



## Hydraulic Equipment

John S. Barnes Corporation, Rockford, Ill. Catalogue EJS on machine-tool and industrial hydraulics, with application recommendations. Covered are Roto-Blade pumps, directional- and pressure-control valves, standard fluid-power units, etc.

Circle Item 560 on Inquiry Card



By E. S. Salichs

# BETWEEN GRINDS

## Be Astuter About Computers

"Do You Talk 'Computerese'?" is the title of a twenty-two page glossary published by the Brown Instruments Division of Minneapolis-Honeywell Regulator Co., and intended to help us with the technical jargon surrounding "electronic brains." For example, such words as *address*, *block*, *drum*, *gate*, *patch*, and *memory* have meanings other than the usual ones we know; then there are words you can't find in the dictionary, like *optimization*. Catch?

## Even Fishing Has Gone Electronic

A steel cable carrying electrical conductors will make it possible for commercial fishermen to use various electrical and electronic devices to indicate the exact depth of their nets, when the nets are on the bottom; the ground speed of their trawl; the size of their catch; and the temperatures where the nets are fishing. The cable was developed by

the American Steel & Wire Division of the United States Steel Corporation—a ship-to-fish service, as it were.

## Cradle to Corral

Among the inventions described in a recent *Products List Circular* (published monthly by the Small Business Administration) is a toy rocking horse which gives the natural stride of a horse trotting or galloping. The thought behind this must be that children want their horses synchronized with those on TV westerns.

## The Magnet of M.I.T.

The world's most powerful magnet will be part of a research laboratory to be built at the Massachusetts Institute of Technology under a \$9,502,000 contract from the Air Research and Development Command. Director of the laboratory, Dr. Benjamin Lax, stated in a release: "The new laboratory will foster activities that enrich our knowledge not only of solids but

also of gases, liquids, and ionized gases, and undoubtedly will contribute to our eventual peaceful use of thermonuclear energy and to the development of new electronic devices." The release ended with the sentence, "Because of the high temperatures generated by the magnets and the need to cool them, water will be pumped to the laboratory through pipes laid to the Charles River." Thank heavens, the old mill-stream still has a place in our way of life.

## Noise Is Necessary

While it pays to cut down on office noise, word has it that you can overdo silence. Seems that people must have a continuous background noise of at least 5 decibels. Otherwise, and we quote, "the worker hears only the thumping of his heart and hisses and creaks of the body." After a strenuous weekend, we'll go along with the thumps and creaks, but we don't understand the hisses—you mean your snake is showing?



**WHO SAYS WE HAVE NO MIS-SILES**—Here is a sleek, deadly nuclear Falcon, the thirty-thousandth air-to-air guided missile to come off the assembly line at the Arizona plant of the Hughes Aircraft Co. And the two pleasant-looking men sandwiching the GAR-11 are (left) John W. Black, manager of the Hughes Tucson facility, and (right) Lt. Col. George E. Scott, Air Force plant representative.

# NEW



## COILGUARD band saw dispenser

EASIER TO STOCK,  
IDENTIFY AND USE



- ★ Coilguard is designed and engineered to guarantee smooth easy dispensing and recoiling.  
Cut end does not protrude.
- ★ Coilguard's high impact plastic protects band saws in transit and in the warehouse.  
Two-way labeling permits identification when stacked vertically or flat.
- ★ Special nesting pins allow "shoulder to shoulder" stocking.  
Hex shape prevents rolling.
- ★ Through center hole facilitates handling, is ideal for mounting on pegs or pipes for dispensing.

Only Capewell Distributors carry bandsaws in the convenient Coilguard package. One more reason why your Capewell Distributor should be your source for all the saws you need—hand hack saws, power hack saws, band saws and hole saws.



THE CAPEWELL MFG. CO., HARTFORD 2, CONN.

more fully for both production and precision operations, Barber-Colman demonstrated the No. 2013 with a quick-change, front-mounted hydraulic tracer. Only ten minutes were required to detach the tracer and replace it with the regular compound rest. This permits economical produc-

tion of short-run jobs, at high stock-removal rates, duplicating consistently within 0.001 inch on diameter and length. This thirty-six-speed machine is available in 20- and 25-inch swing capacities, and is one of four new lathes exhibited by Barber-Colman.

Circle 587 on Readers' Service Card

### Reliance Digital-Controlled Drive System

The Reliance Electric & Engineering Co., Cleveland, Ohio, introduced its new special-purpose digital-controlled drive systems at the recent 1960 Iron and Steel Exposition in Cleveland. These systems are said to offer precise accuracies, rugged modular construction, built-in test equipment, and full system responsibility. On cut-to-length lines, for instance, the new systems are capable of precise cutting to any desired length, calibrated in increments as fine as 1/64 inch.

The principal advantage of a digital-control system is its extreme accuracy. When accuracy requirements are more exacting than 1/10 of 1 per cent, and where system component drift might cause a problem, digital tech-

niques can provide no-drift accuracy. Basically, the digital system operates with information in the form of precise increments, or pulses. In other words, it is a simple, but very exact, counting system. It may be programmed by cards, tapes, or dials and can be built with "memories" and the ability to calculate. The illustration shows a Reliance special-purpose digital-controlled drive system with operator standing at the digital-control cabinet (foreground), which feeds intelligence in the form of electrical signals to the drive cabinet (left background), which in turn supplies the Super "T" drive motor (left foreground) with appropriate electrical power. Feedback from the line is in the form of discrete in-

crements, or pulses, from a pulse generator.

Each Reliance digital system is custom-tailored to specific customer needs, the equipment being specifically designed for the individual application. Modular construction of the digital control systems, coupled with printed circuit boards and Sealpak (complete special-purpose electronic circuits embedded in a solid block of a resilient plastic) construction, provide long, trouble-free life. Individual circuits are built into their own modules for easy check-out and replacement.

Circle 588 on Readers' Service Card

### Selected Natural Diamond Abrasive Grit

The availability of a new type of natural diamond abrasive grit developed specially for use in resin-bonded grinding wheels has been announced by the Industrial Diamond Division of Engelhard Hanovia, Inc., Newark, N. J. Designated "SND" for selected natural diamond, the material is claimed to provide up to 30 per cent greater efficiency than conventional diamond grit for certain operations in the grinding of cemented carbides.

Advantages of the material stem from the geometric shape of the particles, which are predominantly needle-like or thin, flat plates. This is in contrast to the blocky particle shape of conventional natural diamond particles. Bort-crushing techniques have been developed and are being used to produce these special SND shapes.

Because of their shape, SND particles are held much more firmly in the resin bond than the cubical-shaped conventional diamond particles and are not pulled out of the wheel readily. Rather, the thinner particles break down gradually and evenly, continually presenting sharp new cutting edges to the work-piece. Thus more cutting edges are provided per carat than with conventional material. An additional effect is reduced wheel loading and glazing.

In general, the somewhat tougher untreated SND grit is recommended for feeds of between

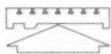


Digital-control system introduced by Reliance Electric & Engineering Co.

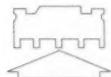
## **When you think of PRECISION**

For life time precision Lucas provides

airlift to saddle

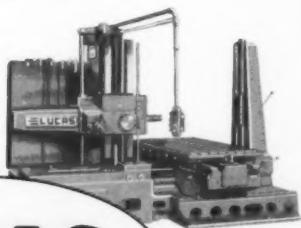


and table.



These elements are supported on a thin film of lubricated compressed air during traverse. This separation of metal from metal virtually eliminates wear. During machining cycles the saddle and table are automatically clamped down tight to provide absolute rigidity for even the heaviest cuts. Unclamping is automatic, too. These are two aspects of Lucas design which contribute to the precision of these machines. Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of Precision . . .

**think of . . .**



**LUCAS**  
PRECISION





## When you think of **RELIABILITY**

Lucas automatic power positioning

automatically repeats 

automatically repeats 

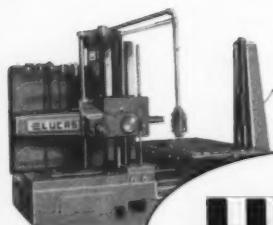
automatically repeats 

to  $\pm .0001 \dots$

A simple, completely reliable system of dial indicators, end measures, and electrical controls automatically disengages rapid traverse, engages the fixed, constant-rate power feed and precision stops the unit at predetermined settings. Automatic power positioning assures the highest order of repetitive accuracy with an absolute minimum of operator attention.

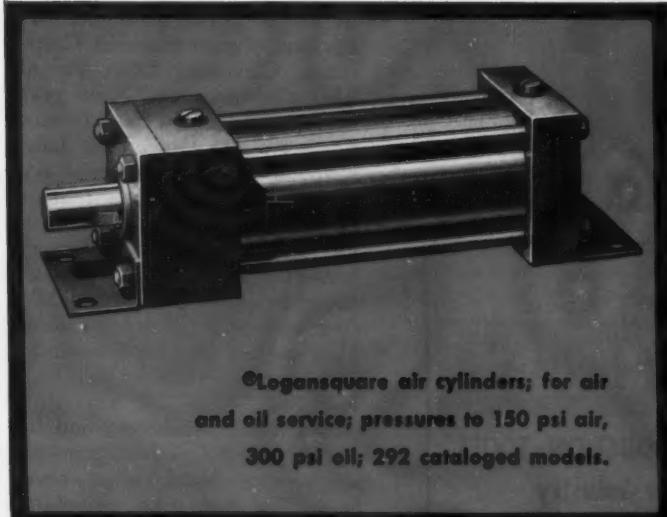
A new catalog describes our complete line of horizontal boring, drilling and milling machines. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of Reliability ...

**think of ...**



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PRECISION

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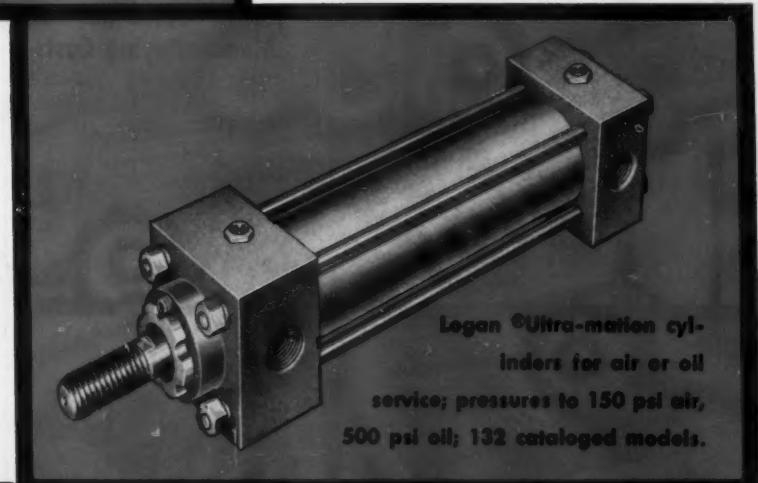
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on the "rights" and "wrongs" in setting up  
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0.0005 and 0.0015 inch and higher. The treated SND grit will provide the greatest efficiency increase at extremely light infeeds of under 0.0005 inch, though benefits will still be significant in cuts of up to 0.001 inch. For extremely heavy infeeds, 0.003 inch and over, the company recommends conventional natural diamond grit, which is also the preferred material for vitrified and metal-bonded grinding wheels.

Circle 589 on Readers' Service Card



### Flange-Head Fittings Added to Hozelok Line

Flange-head ends and bent-tube fittings with 37-degree swivel nuts have recently been added to the line of Hozelok reusable fittings of the Parker Fittings & Hose Division, Parker-Hannifin Corporation, Cleveland, Ohio. Various hydraulic units now have ports machined for flange-head connections. The flat area of the flange head has a groove for an O-ring seal. The flange head is attached by a split clamp fastened with four bolts to the connected member. Flange-head fittings include straight-connector and 45- and 90-degree elbow types as stock items. They are provided for five sizes of Parker's two-wire-braid high-pressure hose, from 3/4 through 2 inches (inside diameter), and for six sizes of medium-pressure, single-wire-braid cotton-cover hose. The bent-tube swivel-nut fittings, in 45- and 90-degree elbows and a long 90-degree elbow, are available for high-pressure hose from 1/4 through 1 inch and for medium-pressure hose from 5/16 through 7/8 inch. The swivel nut provides a metal-to-metal seating with SAE hydraulic 37-degree flare cone of the company's hose-fitting adapters and tube fittings.

Circle 590 on Readers' Service Card



# BERKROY

**PRODUCTION TOOLS**

**Designed for Industry**

**...to Cut  
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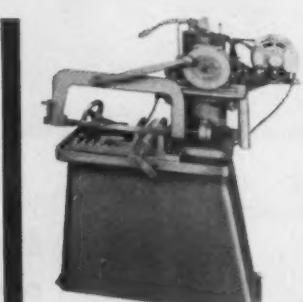


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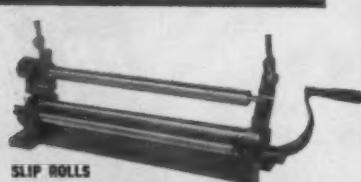
- Nibbler-Slitter • 12" Brake • 12" Slip Roll
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**BOX AND PAN BRAKE**  
Accurate, Versatile. 24" - 30" - 36"



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Two sizes — 4x4, or 6x6 inch  
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Fully enclosed steel gears.  
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### Double-Carbide Saw Blades

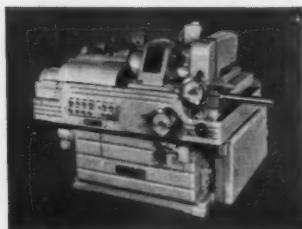
A double-carbide alloy band-saw blade manufactured by the L. S. Starrett Co., Athol, Mass., is said to cut 50 per cent faster than carbon bands and enables standard band-saw machines to operate at close to maximum efficiency. Called Alloy Band, it has improved hot hardness and abrasion resistance. Materials that can be cut include many of the tougher alloy steels.

Circle 591 on Readers' Service Card



THREAD GRINDING COSTS TOO HIGH?

# Here's How a Modern Ex-Cell-O can Increase Production and Lower Your Labor Costs

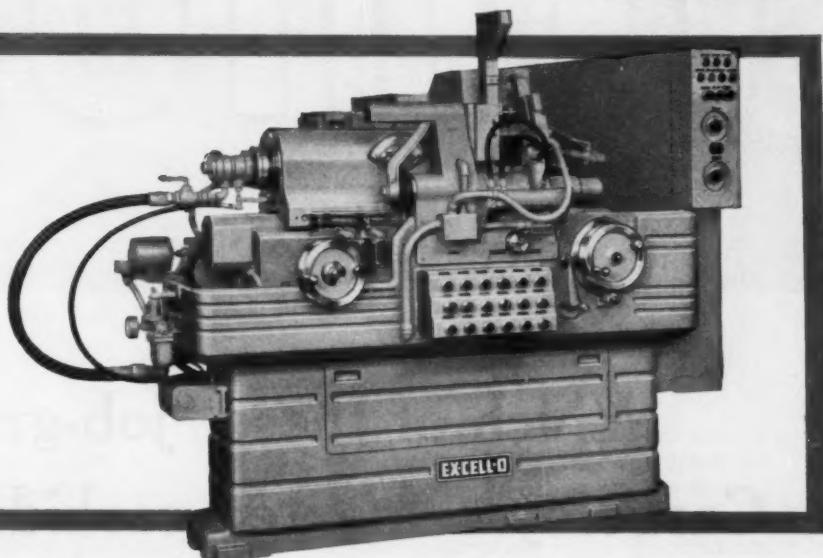


**1939**—Style 39 Ex-Cell-O Internal Thread Grinder, then the fastest of its kind, produced 17 automotive steering gear ball races per hour. It had power wheel dresser, automatic dresser compensation and automatic wheel feed.

**1946**—The part's the same, but the manufacturer has turned to a postwar Ex-Cell-O Style 39-A Precision Thread Grinder with fully automatic grinding cycle, including automatic wheel dressing at predetermined intervals. Operator simply loaded the part, reset the size handwheel and pressed the start button. Production increased to 24 parts per hour.



**1960**—Modern Style 39-A, today produces the same basic part but now at a rate of nearly 60 parts per hour. This powerful, versatile machine has a high-speed workhead, high-frequency Bryant Grinding Spindle, automatic loading, unloading and cycling. It requires only the part-time attention of one unskilled operator.

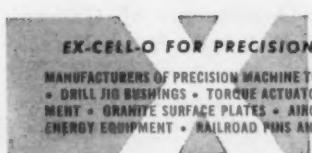


**TOMORROW**—Will you have a similar long-run part, or perhaps pinions, worms, taps, thread gages, lead screws, missile components or other special parts that cannot be rough- or finish-ground economically on your present equipment?

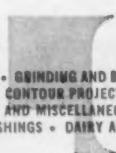
Your local Ex-Cell-O Representative can show

you how modern Ex-Cell-O Precision Thread Grinders can substantially reduce the cost of producing a wide variety of your large and small threaded parts. Call him today, or write direct for details on the complete line of Ex-Cell-O Internal, External and Universal Thread Grinders for every toolroom and production job.

60-33



MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS  
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Machinery Division

**EX-CELL-O**  
CORPORATION  
DETROIT 32, MICHIGAN

# Which?

Which of these "job-graded" Carboloy® cemented carbides is right for your operation? And why?

What is your machining problem? Carboloy cemented carbides are job-graded for *every* disposable insert and carbide-cutting-tool application as a solution to your problem. Job-graded to help you choose the *right* carbide. Job-graded so you can count on optimum results from every Carboly tool or insert you use. *And, with Carboloy carbides, you get the same consistent quality order after order after order!*

**Carboloy inserts for steel-cutting grades  
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Ready-to-use inserts honed to a precise radius in a complete line of job-graded carbides — that's what

you get when you specify pre-honed Carboloy cemented carbide inserts.\* Designed to reduce chipping, increase predictable tool life, withstand cutting pressures better, Carboloy pre-honed inserts offer savings in time and labor.

Your Carboloy representative or Authorized Distributor is the man who can best fill you in on the job-graded carbide best suited to *your* machining requirements. Contact him today . . . or write: Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Road, Detroit 32, Michigan.

\*Carbides in the 78 series are all pre-honed. Carbides in the 300 series are available pre-honed, precision-ground, or utility ground.



### 78 SERIES GRADES

Where machine capacity is limited, the low initial tool cost of 78 series carbides provides real economy in normal steel-cutting operations; offers optimum output-per-dollar. In this series, the improved 78B grade is best to use where carbides are being initially applied to steel-machining operations. All disposable carbide inserts in the 78 series come pre-honed to serve you better; save you time and labor.

### 300 SERIES GRADES

Heavy-duty, heavy-feed steel-cutting applications? Then a carbide from the 300 series is the one to choose. This is the Carboloys series designed to cover a wide range of steel-cutting operations — everything from precision finishing to heavy-duty roughing — all at a lower cost-per-piece for such a variety of jobs. Most inserts in the 300 series are available pre-honed, precision-ground, or utility ground.

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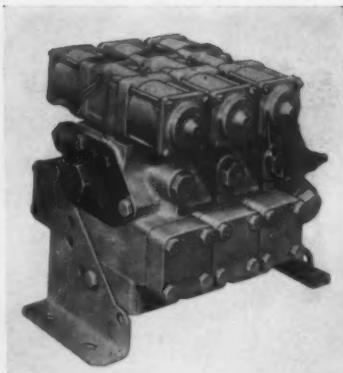
MACHINERY, November, 1960

For more data circle this page number on card at back of book

205

## Mobile Stackable Valve

A 25-gpm, four-way, separate-segment stackable valve developed by Racine Hydraulics & Machinery, Inc., Racine, Wis., features solenoid operation and extreme adaptability. The unit, produced by the firm's Mobile Division, is available in series- or parallel-circuit stack assemblies, with ten or more operating segments. The stacks can include relief valves and pilot pressure-control valves for solenoid, remote pilot, manual,



or mechanical control. Any combination of the control variations can be combined in one multiple-valve stack. Pilot pressures can be internal or external. Additional features include an adjustable-pilot choke control to vary speed of spool for shock elimination; good metering characteristics; and spring-centered, spring offset, or detented main spool for manual and mechanical control. A built-in flow allows independent adjustment of cylinder speeds in either direction. The valve has a continuous-duty pressure rating of 3000 psi. It has straight-threaded porting for 7/8-inch (outside diameter) tubing.

Circle 592 on Readers' Service Card

# new GREAVES 2-XH Milling Machines

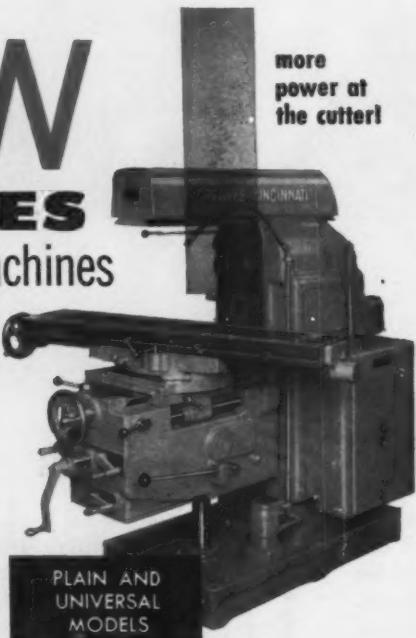
The completely new GREAVES No. 2-XH Milling Machine brings added versatility, increased operational ease, and more power where it's needed most . . . at the cutter!

It utilizes two motors, one for spindle drive; a separate motor for moving table, saddle and knee. Compare this and the other outstanding features of the new Greaves Mill. You'll see why Greaves is "The MOST Mill for the LEAST Money."

Write for detailed literature!

# GREAVES

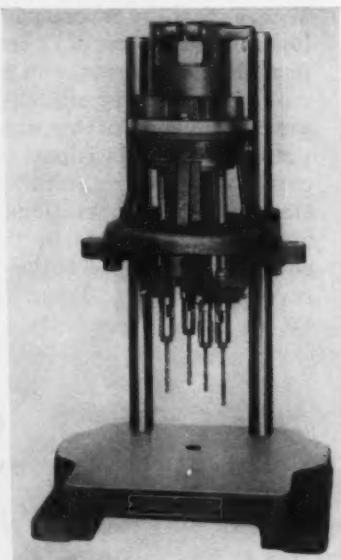
J. A. FAY & EGAN COMPANY  
2500 Eastern Avenue, Cincinnati 2, Ohio



- Wide range of speed/feed combinations for any type material, any type job.
- Heavy, internally ribbed column casting and heavy duty rectangular overarm for maximum rigidity.
- Large, heavy-duty knee, saddle and table provide accuracy for all types of milling.
- New 7 1/2 HP spindle drive motor, with separate motor for movable components, provides extra power for heavy milling.
- Easy-to-reach controls. Handwheels and vertical crank disengage automatically when not in use.
- New rapid traverse lever within operating control area.
- Separate drive motor for table, saddle and knee provides more smooth balanced power at the cutter.

## Multiple-Spindle Drilling and Tapping Heads

A Model 400 Knuckle-Head fully adjustable four-spindle drilling and tapping head designed to meet the demand for a compact, lightweight unit to perform small delicate production operations is a new product of the Ettco Tool & Machine Co., Inc., Brooklyn, N. Y. Small and easy to handle, this head eliminates the need for using larger, more expensive and cumbersome adjustable heads for most of the smaller jobs. It operates in any

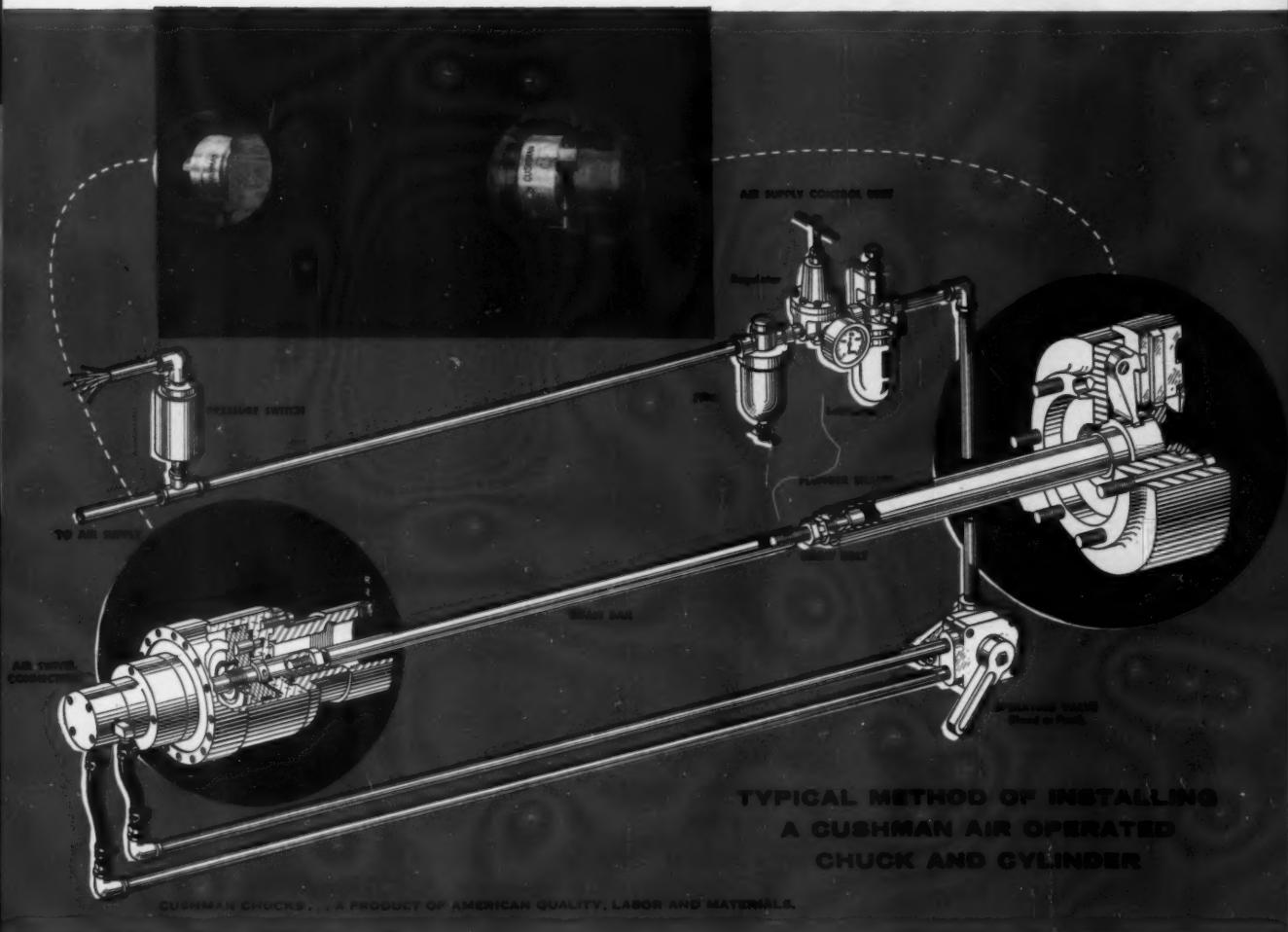


Multiple-spindle tapping head brought out by Ettco Tool & Machine Co., Inc.

Get a production bonus with

**CUSHMAN**

AIR OPERATED CHUCKING EQUIPMENT



TYPICAL METHOD OF INSTALLING  
A CUSHMAN AIR OPERATED  
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CUSHMAN CHUCKS...A PRODUCT OF AMERICAN QUALITY, LABOR AND MATERIALS.

**SIMPLE TO INSTALL • EASY TO OPERATE • LOW IN COSTS**

Yes, Cushman Air Operated Chucking Equipment automatically provides a bonus of increased production by eliminating operator fatigue—the principle cause of rejects... raising production rates with better accuracy and higher efficiency... decreasing floor-to-floor time. Safe, positive work

piece grip permits accurate control of jaw pressure for the material being machined.

Write today for Bulletin No. PO-66D and see for yourself how you can increase production and reduce machining costs on both new and old equipment at a surprisingly low investment.

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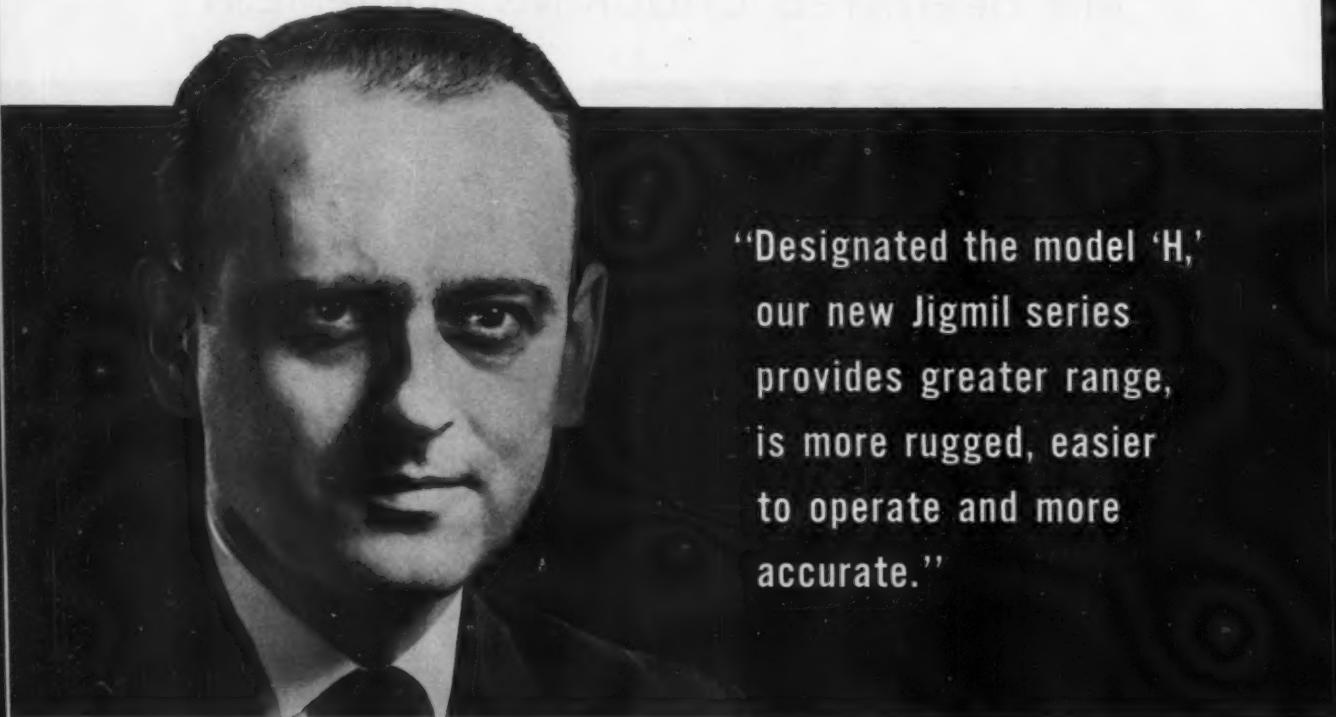
THE CUSHMAN CHUCK COMPANY • HARTFORD 2, CONN.

MANUFACTURERS OF CUSHMAN POWER WRENCHES, MANUALLY OPERATED CHUCKS AND FACE PLATE JAWS.



NEW FROM FAIR STREET • HOME OF THE JIGMIL

# new series



"Designated the model 'H,' our new Jigmil series provides greater range, is more rugged, easier to operate and more accurate."

"Available in spindle sizes ranging from 3" to 5", the new 3H, 4H and 5H machines greatly increase JIGMIL range for precision boring, milling, drilling and other operations. The new series introduces simplified controls, thermal control of main spindle bearings for increased accuracy . . . wider bed and table for added stability and working range . . . stainless steel way covers for positive protection . . . features that reach a new standard in JIGMIL accuracy, ruggedness and simplicity of operation. And like all JIGMILS, the 'H' series is available with the DeVlieg Diatrol direct dial dimensioning system or Tapac\* —DeVlieg's own system of automatic tape control."

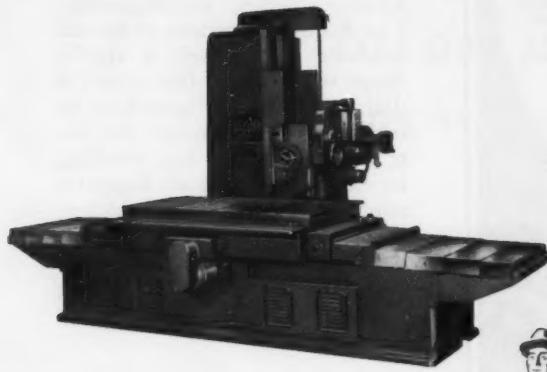
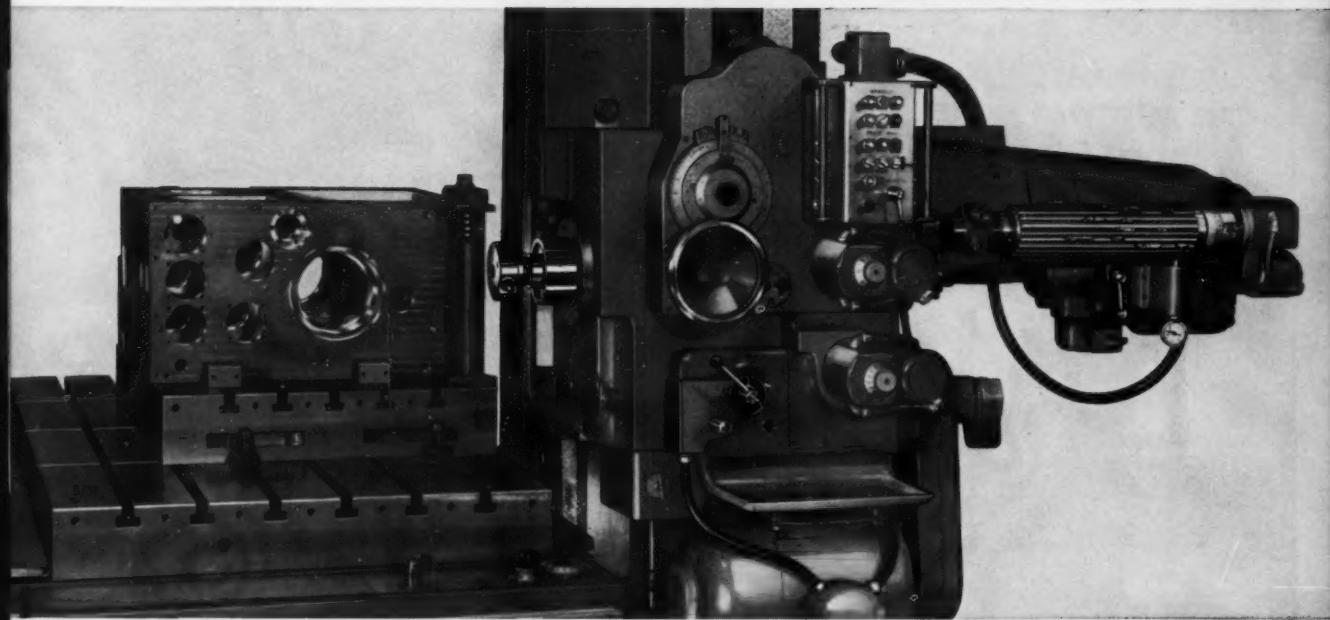
R. A. JERUE  
*Vice President in Charge of Engineering*

\*Tape Automatic Positioning And Control

DEVLIEG MACHINE COMPANY, FAIR STREET • ROYAL OAK, MICHIGAN

# "H" Jigmills®

with Duplitrol • Diatrol • Tapac



Illustrated above is a Precision Spindle Head Casting being machined on a Model 3H-72 Spiramatic JIGMIL. Series 3H machines have 3" diameter spindle bar, 36" vertical travel and 48", 72" or 96" horizontal travel, designed for machining all types of production work and one-piece jobs in the medium size range.

**DeVlieg**  
**SPIRAMATIC**  
**JIGMILS®**

ACCURATE HOLES AND FLAT SURFACES  
IN PRECISE LOCATIONS

Rewarding revelations in automatic precision  
await your next visit to Fair Street

position on any drill press, drilling or tapping unit, or machine. It will either drill or tap from two to four holes ranging from  $1/32$  to  $1/4$  inch in steel.

The spindles are of the universal joint type and can be easily adjusted to almost any hole pattern within a bolt circle 4 inches in diameter with a  $5/8$ -inch minimum center distance. Special spindles allowing a  $1/2$ -inch minimum center distance are also available. Adjustment of the spindles to the desired position is

by means of a locating arm which, like the spindle shaft, can be added or removed without tools.

Where the advantages of fixed spindle operation are desired, aluminum templates, jig-bored as required, can be supplied in place of adjusting arms. Guide bushings are provided in the gear-case to permit the use of guide rods for maximum rigidity and alignment. The gear case of the Model 400 is aluminum alloy and provides a 1-to-1 ratio drive.

Circle 593 on Readers' Service Card

# NEW

## HAMILTON VARIMATIC® PRECISION DRILLING MACHINE

**SUPER SENSITIVE CAPACITY TO  $5/16$ "**

Brings a new dimension to the production drilling of small precision holes. Drills to the center of a 10" circle. Head swings radially on column and locks at any position. 6" vertical adjustment of head on column.  $2\frac{1}{2}$ " feed of spindle. Speeds from 840 to 9300 R.P.M. infinitely variable in two ranges.

If you would like the complete Varimatic story . . . with pictures, and a sectional engineering drawing . . . write for our FREE Bulletin No. V/2961.

*It's a* **2961**

*use it with confidence!*

**THE HAMILTON TOOL COMPANY**

834 SOUTH NINTH STREET HAMILTON, OHIO

### Totally Enclosed Motor

Totally enclosed, fan-cooled, single-phase motor introduced in capacities of 1 to 5 hp by the Brook Motor Corporation, Chicago, Ill. Internal fans, cast integrally with the rotor, recirculate air and eliminate hot spots. A large external fan, protected by a hood, blasts air over the heat-dissipating fins, which are cast integrally with the frame. No dust or moisture can enter the motor. Condensate inside the motor can

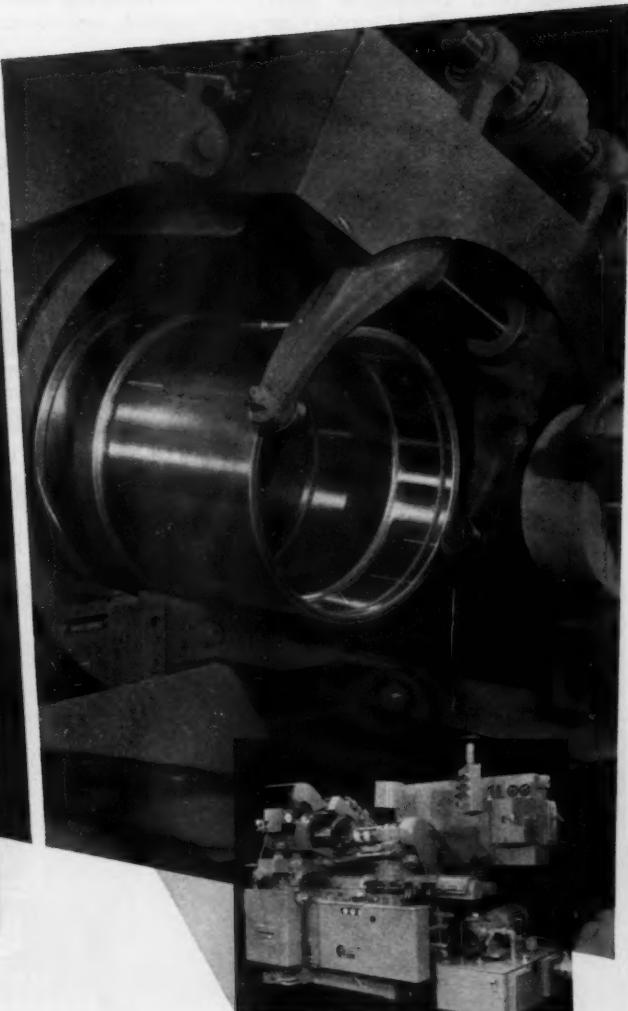
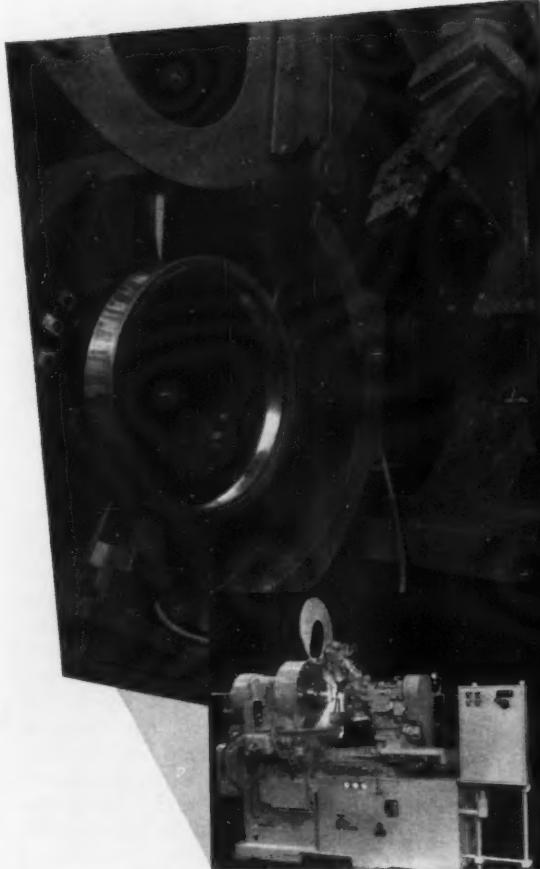


be bled off by means of two plugged openings. A feature is the external centrifugal switch mounted on the outside of the motor where it is made easily accessible through the removal of a protective cap. The same switch fits all sizes of motors. It positively disengages when the motor has attained preset speed. Thus there is no danger of the motor operating on both starting and running current simultaneously. The stator has sections of special annealed alloy steel, is rigidly keyed to the motor frame, and is designed to further contribute to cool operation. Through the use of new methods of coil winding, internal connections are kept to a minimum. While the capacitor occupies a minimum of space, it is designed for long, carefree operation.

Circle 594 on Readers' Service Card

### Coolant for Broaching and Rifling

A coolant or cutting oil, known as "Shear-Speed" H-109, formulated to provide the necessary cooling and load-carrying properties required for the toughest



**tailored...**

**For long or short runs on large bearings**

Whether you are grinding a range of bearing races involving one shape in various sizes, or parts which involve a complete change in configuration — for example, from roller bearings to ball tracks — the versatility and tailored tooling of Bryant Internal Grinders assure you of record production rates and consistently high quality.

Contact your nearest Bryant or Ex-Cell-O sales representative and let him show you how Bryant Internal Grinders can improve your production of varied workparts.

## **BRYANT Chucking Grinder Co.**

20 Clinton Street, Springfield, Vermont

*Precision Internal Grinders, Spindles, Special Machinery and Components*

metal-cutting work, has been developed by Shear-Speed Chemical Products, division of Michigan Tool Co., Detroit, Mich. This new oil has been thoroughly field-tested in diversified production operations. It is said to provide excellent chip-load distribution and do an outstanding job in producing improved finishes during internal horizontal broaching and rifling operations on soft, tough, or stringy metals.

The efficient cooling and lubri-

cating properties provided by this clean, pleasant-smelling, nonirritating oil are said to increase operator efficiency. The oil contains no irritating additives and thus protects against skin irritations.

Circle 595 on Readers' Service Card

### Moore Jig Borer Features Three-Position Clutch

A popular-priced No. 1 1/2 jig borer, combining the advantages



Jig borer with three-position clutch announced by the Moore Special Tool Co., Inc.

**EFFICIENT...  
ACCURATE...  
DEPENDABLE**

**L & J**  
150 TON  
STRAIGHT SIDE  
PRESS

**STANDARD EQUIPMENT  
ALL HIGH QUALITY**

Including—Air clutch. J.I.C. wiring and controls. Shaft driven limit switch. Solenoid-controlled dual air valve. Replaceable wear strips on slide. Hard bronze crankshaft bearings. Replaceable ball seats. Air counter balances on slide. One-shot forced lubrication. Gears run in oil. Optional equipment as required.

- Single geared, twin end drive, double crank.
- Maximum quality throughout.
- Long, square gibbing maintains perfect slide alignment.
- Heavy welded steel box-type frame with tensioned tie rods insures rigidity.
- Proven L & J quality gives long, dependable service and cuts maintenance costs.
- Large die space — 48" x 36" slide face, 48" x 36" bolster area.

**WRITE** for complete information on 20- to 150-ton straight side presses, 14- to 150-ton O.B.I. presses and 30- to 75-ton gap frame presses.

**L & J PRESS CORPORATION**

1631 STERLING AVE.  
ELKHART, IND.

of its No. 1 and No. 3 models, is announced by the Moore Special Tool Co., Inc., Bridgeport, Conn. Designed for working to very close tolerances, the No. 1 1/2 jig borer offers a greater range and larger table—10 1/2 by 19 1/2 inches—than its No. 1 predecessor, which was discontinued in 1955.

A special three-position clutch (start, indicate, and brake), conveniently accessible for easy control by the operator, is an unusual feature of this jig borer. In addition, fourteen important features, not found in the preceding model, are said to make this machine extremely accurate and outstanding in performance. These features include: closer tolerances; infinitely variable spindle speeds—120 to 2400 rpm; vee and flat ways; the elimination of gibs and overhang; single lever, front and back table clamps; more accessible clamping; two feeds instead of one; micro-setting of vernier dials; protected chrome-plated dials and reference scales; accurate lead-screws of 1 3/8-inch diameter Nitroloy; wider column and V-ways; greater rigidity and increased weight (2300 pounds compared with 1700 for No. 1); and conformity to JIC standards.

Circle 596 on Readers' Service Card



Using basic components, seven different arrangements are possible, as shown above. Spindle drive motors can be mounted at right, left, or on both sides with single or double spindles; two machines can be placed side-by-side or used with other production machines.

# The 4 BIG Features of Ex-Cell-O's New 411 Vertical Are Important To You

**1. QUICK TOOL CHANGING**—Tool changing and adjusting is fast and easy because of "clean" design and placement of the Model 411's components.

**2. EASY PARTS HANDLING**—Vertical construction lends itself to safe, easy loading and unloading of parts in a wide variety of shapes and sizes.

**3. SINGLE COLUMN CONSTRUCTION**—Solid base-column gives firm support to the hydraulically-operated compound tool slide. Rugged, simple

construction assures maximum accuracy and efficiency, plus long life with lowest maintenance.

**4. PRODUCTION VERSATILITY**—The all-new Model 411 performs turning, boring, racing, grooving, limited contouring and chamfering operations singly or in combination. Often, both sides of disc-type parts can be machined simultaneously.

Contact your Ex-Cell-O Representative or write direct for details.

**EX-CELL-O FOR PRECISION**

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • SAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

*Machinery Division*

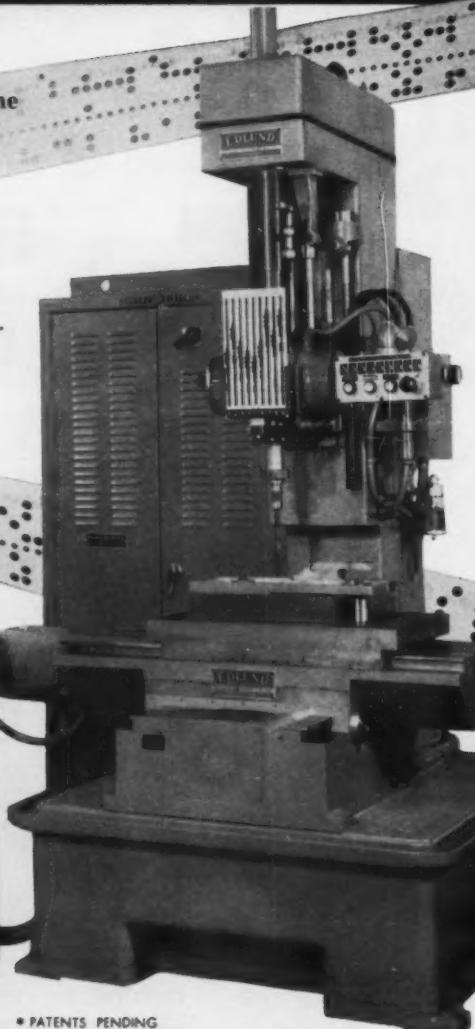
**EX-CELL-O**  
CORPORATION  
DETROIT 32, MICHIGAN

# EDLUND-MATIC NUMERICAL TAPE CONTROLLED DRILLING & TAPPING MACHINE

The newest Layout Drilling Machine with Numerical Tape or Dial Control. Economically performs multiple operations for Single Piece Layout Work Short Run Production The entire sequence of operations can be repeated time after time with no chance of operator error— minimizes operator attendance and skill.



\* PATENTS PENDING



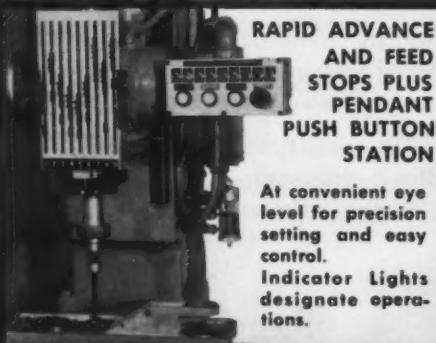
## FEATURES

- Flexibility in setting up a wide variety of operations.
- Quick conversion from one drilling job to another.
- Work from standard detailed drawings.
- Standard 1" 8 channel punched tape.
- Tape or Dial control.
- Infinitely variable spindle speeds 225-2700 rpm.
- Infinitely variable feeds 1 to 7 inches per minute.
- Nine different operations or tool changes at one setting.
- Foolproof tool rack (available) prevents use of incorrect tool.

FEATURED  
at the National  
Machine Tool  
Exposition

Write for Bulletin 200.

**CONTROL CONSOLE**  
Operation Selector Switch and Lights for nine operations  
Spindle Speed and Feed Setting Knobs and Tachometers.  
Table Positioning Dials for two axis, Zero Offset Dials.



RAPID ADVANCE  
AND FEED  
STOPS PLUS  
PENDANT  
PUSH BUTTON  
STATION

At convenient eye level for precision setting and easy control.  
Indicator Lights designate operations.

## EDLUND COMPOUND TABLE

A new concept in extremely rapid positioning table. Many exceptional features. Table Travel 14" x 20". 200"/per min.



Special Contract Job work can also be arranged with Edlund. Send Part, Blueprint and Requirements.

**EDLUND**  
MACHINERY COMPANY  
Cortland, New York Division of Harsco Corporation

EDLUND REPRESENTATIVES  
IN MAJOR CITIES

# EDLUND GUN DRILLING PRODUCTION & SENSITIVE DRILLING MACHINES

Edlund's complete line of Drilling Machines backed by over 40 years of specialized drilling experience assures you the very best in engineering and construction. Edlund's reputation for maintained accuracy without downtime over long periods plus a capable dealer service organization throughout the entire United States has the answer to your drilling requirements.

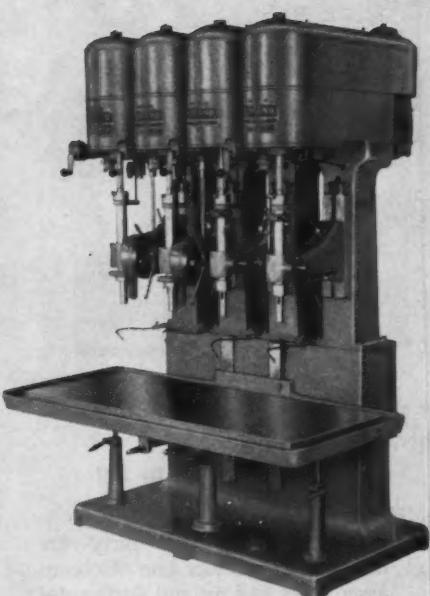
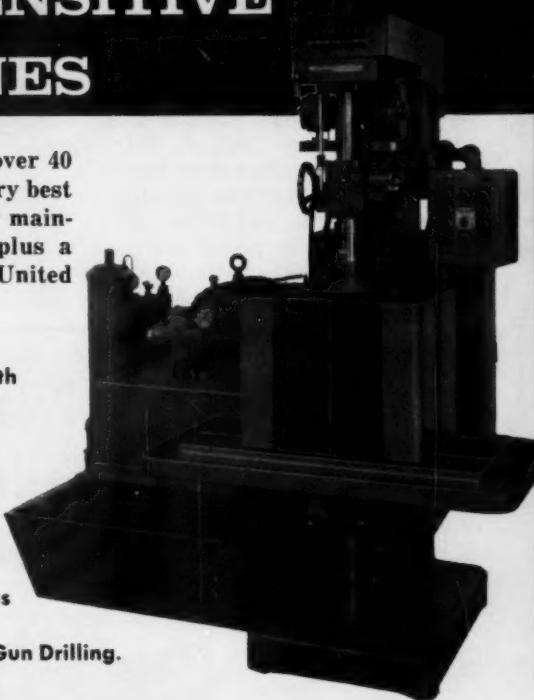
## EDLUND MODEL 2G

Gun Drilling Machine with  
Edlund Model 2HPC High  
Pressure Coolant System

The most efficient unit  
for producing accurate  
and smooth holes at  
production rates.

Capacity  $\frac{3}{8}$ " in steel.  
For complete specifications  
write for Bulletin 2GR

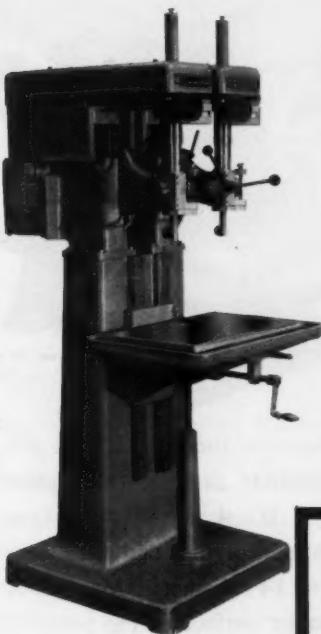
FREE! Special Report on Gun Drilling.



## EDLUND MODEL 2F HEAVY DUTY DRILLING AND TAPPING MACHINE

Infinitely Variable Spindle Speeds  
available in spindle combinations from  
1 to 8 with 8", 12" or 15" overhang.  
Capacity 1" in cast iron.  
For complete specifications write for  
Bulletin 140R

Also EXTRA HEAVY DUTY MODEL 4F,  
Capacity in cast iron to 1 $\frac{3}{4}$ ".  
1 to 4 spindles, 12" overhang.  
Write for Bulletin 170R.



## EDLUND MODEL 1F

High Speed Sensitive Drilling  
Machine for small parts and light  
assemblies.

1 to 6 spindles, 7" and 10" overhang.  
Capacity in cast iron to  $\frac{3}{8}$ ".  
Speeds to 10,000 RPM.  
Pedestal or Bench types.  
Write for Bulletin 160R.

## Also MODEL 1 $\frac{1}{2}$ F

1 to 6 spindles, 7" and 12" overhang.  
Capacity to  $\frac{3}{8}$ " in cast iron.  
Speeds to 6,000 RPM.  
Write for Bulletin 165.

**SPECIAL MODELS ENGINEERED TO ORDER.** You can call upon Edlund to design special application machines for you. Edlund Cam Feed Units are readily adaptable to specialized drilling operations. Specifications and quotation submitted promptly on request.

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# EDLUND

MACHINERY COMPANY  
Cortland, New York

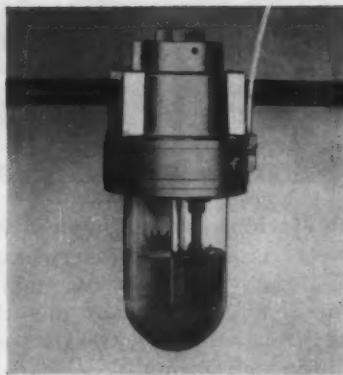
Division of Harsco Corporation

Special Contract Job work  
can also be arranged with  
Edlund. Send Part, Blueprint  
and Requirements.



## Crown Lubricator for Air-Operated Equipment

A Crown pulse lubricator for air-operated equipment delivers exactly the required amount of oil to the spot where lubrication is needed. The system operates on pressure variations (pulses), and is entirely independent of air-flow rates and duration of flow periods. Because the outlet end of the oil-delivery line can be placed in any location, oil delivery to the exact spot desired is assured without the



## NEW Abrasive Saw Rotates Metal . . . Cuts 16 to 20 IPM's on Hard Alloys



If you produce large rounds or squares, the new Rotator will reduce your cutting time to a minimum . . . 16 to 20 square inches per minute on hard alloys. It's the only rotator-type saw with a chuck that will hold rough forgings and rounds, as well as conventional rounds up to 14" diameter. Material is rotated as it is cut, keeping a cooler surface at the point of blade contact . . . result — longer blade life. Self-contained and portable, with integral tank and re-circulation pump.

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TY-SA-MAN Machine Co., Inc.  
1093 White Ave., Knoxville, Tenn.

**Ty-Sa-Man**

SINCE 1885

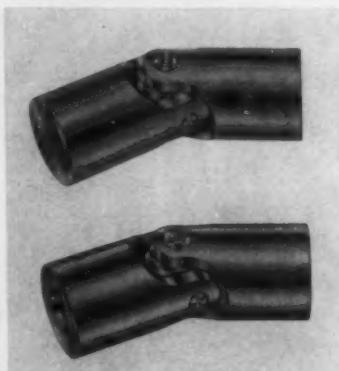
need for a costly, auxiliary pressurized oil supply. Metering can be controlled from a drop every three or four pulses to a drop every 100 or more pulses. The lubricator is made by the Hannifin Co., a division of Parker-Hannifin Corporation, Des Plaines, Ill.

Circle 597 on Readers' Service Card

## Quincy Stainless-Steel Universal Joints

Universal joints now available in stainless steel from distributors of Boston Gear Works, Quincy, Mass. The selection includes solid or bored types in ten sizes ranging from 3/8 to 2 inches in diameter, and 1 3/4 to 5 7/16 inches in over-all lengths.

Circle 598 on Readers' Service Card



## Morton Clamp, Jig and Fixture Details

In addition to their thirty-year old regular product line of clamp assemblies and jig and fixture details, the Morton Machine Works, Millersburg, Pa., division of Brubaker Tool Corporation, is now manufacturing a complete line of "Morton Midgets," designed specifically for the "Miniaturization Age."

Made of nonmagnetic, corrosion-resisting stainless steel, these items are heat-treated where needed and all are liquid-honed to produce smooth nonmarring surfaces. Substantial savings are said to have been realized by toolmakers and contractors serving the instrument, computer, electronics, aircraft, and missile industries through the use of these assemblies and components.

Circle 599 on Readers' Service Card

# YOURS..... *a library of literature on* **MACKLIN** *"wheels of profit"*



*Looking for new economies in your production grinding? The answers you've been looking for may well be in this new Macklin literature. It contains specific wheel recommendations for various operations, and is documented with actual case histories showing cost-saving applications.*

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- Literature on () Snagging Wheels () Tumbling Media  
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**MACKLIN** company

Dept. 14, Jackson, Michigan

## Thinline Motor with Face Mounting

Motor with NEMA Type "C" face mounting added to the Thinline motors now available from the General Electric Co., Schenectady, N. Y. This motor is designed for use on pumps, gears, hoists, and propeller type fans. It is available in both dripproof and totally enclosed constructions in ratings from 1 through 5 hp at 1800 rpm; 3/4 through 3 hp at 1200 rpm; and 1/2 through 2 hp at 900 rpm. The



Thinline NEMA Type "C" face motor is as much as 7 inches shorter and up to 20 per cent lighter than equivalent standard NEMA Type "C" face round frame motors. The frame and end shields are of rigid cast-iron construction.

Circle 600 on Readers' Service Card

## Gear Tester Available with Recorder

Michigan Tool Co., Detroit, Mich., announces that its low-cost No. 607 bench type roll tester for gears with center distances from 1 3/4 to 6 inches is now available with a checking recorder as extra equipment. The standard tester has a spindle type mounting stud for the master gear. If it is desired to use it as a conventional tester, a set-screw locks the stud. It will check size, eccentricity, and meshing smoothness of helical and spur gears from 8 to 48 pitch. When used with a dial indicator, deflections are shown in increments of 0.0005 inch.

Circle 601 on Readers' Service Card

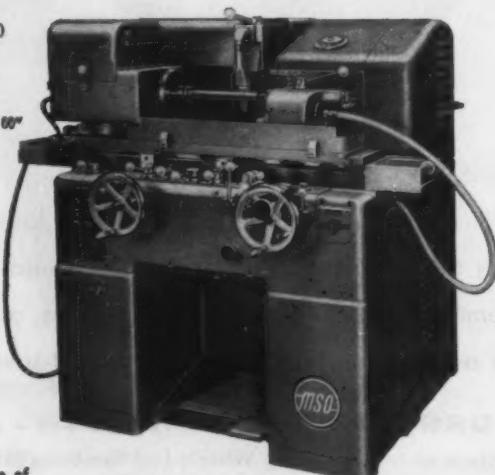
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Since 1865

For automatic production in plunge or traverse grinding MSO Hydraulic Grinders offer ease and speed of operation with single lever control, automatic cycling including variable spark-out to fine finish and preset size — against positive stop (repeat accuracy .00004") or by electric gauge.

Model FH-200 (Illus.)  
Swing 10"  
Model FH-100  
Swing 7"  
Model FH-300  
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MSO offers  
a complete line of  
precision grinding machines  
with features such as:

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- + Precimatic sizing
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austin industrial corporation

76E Mamaroneck Avenue

White Plains, New York



## Why in the past 12 months hundreds of PLANTS HAVE SWITCHED TO CLEARTEX!

These automatic screw machine users have found that tri-purpose Cleartex has ended the problem of cutting oil dilution.

Manufacturers have found that in 7 out of 10 automatics, lube oil leaks into the cutting oil sump in spite of the most careful lubricating techniques. This diluted cutting oil can cause shortened tool life and piled-up rejects.

**New Texaco Cleartex has solved the problem forever** for many manufacturers. They now use Cleartex for both cutting and lubricating, hence the leakage that occurs no longer dilutes the cutting oil quality. The exceptional chemical stability and load-carrying ability of the Cleartex series make them equally suitable for use as cutting oils, lubricants and even hydraulic fluids.

**TRY THE "CLEARTEX CURE" YOURSELF.** Write today for Texaco's booklet—"Cleartex in Automatic Screw MACHINERY, November, 1960

Machines." This illustrated guide will fill you in on the details, show you where you may be losing profits and how to avoid it. Or contact your local Texaco Lubrication Engineer for an authoritative study of your automatics. Just call the nearest of the more than 2,300 Texaco Distributing Plants or write to:

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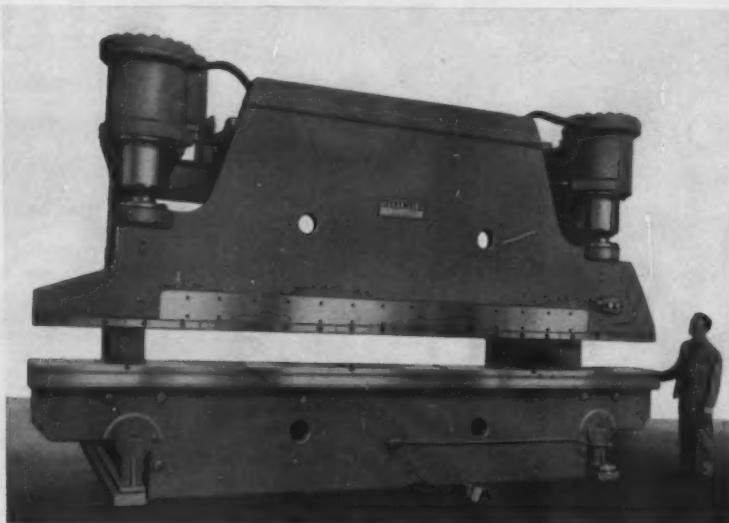


can be turned in either direction and moves the tool accordingly—with no backlash problem. Each of twenty dial divisions on the screw indicates a movement of 0.050 in. The 00 size holder cur-

rently available has a 5/8-inch hardened and ground shank that accommodates 1/8- to 3/8-inch round shank tools. Boring capacity is 1 1/4 inches diameter.

Circle 602 on Readers' Service Card

### Steelweld Deep-Bed Hydraulic Press Brake



Steelweld hydraulic press brake rated at 650 tons at the midstroke position of the ram

A large Steelweld hydraulic press brake with a deep bed that is extended 36 inches below the floor to assure minimum deflection and extremely accurate bends has just been shipped to a metal-fabricating plant by the Steelweld Machinery Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio. This machine is rated at 650 tons at midstroke; it has an over-all bed length of 20 feet 3 inches and a distance between housings of 14 feet 4 inches. A 15-inch bed and ram extension is provided at the left end.

The ram is powered by two hydraulic cylinders and can be started, stopped, or reversed at any point in the stroke. This enables the ram to be inched towards the work or away from it wherever desired. The unusually long stroke of 16 inches is an advantage when handling deep bending and drawing work or where high dies must be accommodated. The power is constant for the entire stroke, which may be quickly adjusted to any length and between any points within the capacity limits of the machine.

The press has three operating speeds. Ram approach and return speed is 90 ipm; half-tonnage pressing speed is 45 ipm; and full-tonnage pressing speed, 22 ipm. By simply turning a knob, the tonnage, or operating pressure, may be changed to suit the work.

Regardless of where the work is placed along the bed, the ram will remain level or at any taper at which it is set. Either end of the ram can be tapered as much as 1/8 inch per foot of ram length. An outstanding advantage of this press is that it cannot be overloaded. Regardless of the size of plate put into the press, it cannot be damaged; the ram will simply stop and can be backed away immediately.

Circle 603 on Readers' Service Card



# TECHNICA

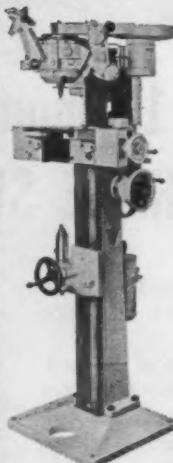
**The NEW CENTER GRINDING MACHINE for GENERATING CENTERS**

The Only Way to Produce True Centers, Precisely, Quickly, and Economically.

Send today for our new 12 page catalog — "Free". Complete information about all famous Technica Center Generating Machines.

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WESTFIELD, NEW JERSEY

Shown Below  
Technica ZSM Center Hole Grinding Machine



To: High Precision Products, Westfield, New Jersey

Please send catalog and prices for new Technica Center Generating Machine.

One

Two

Name.....

Firm Name.....

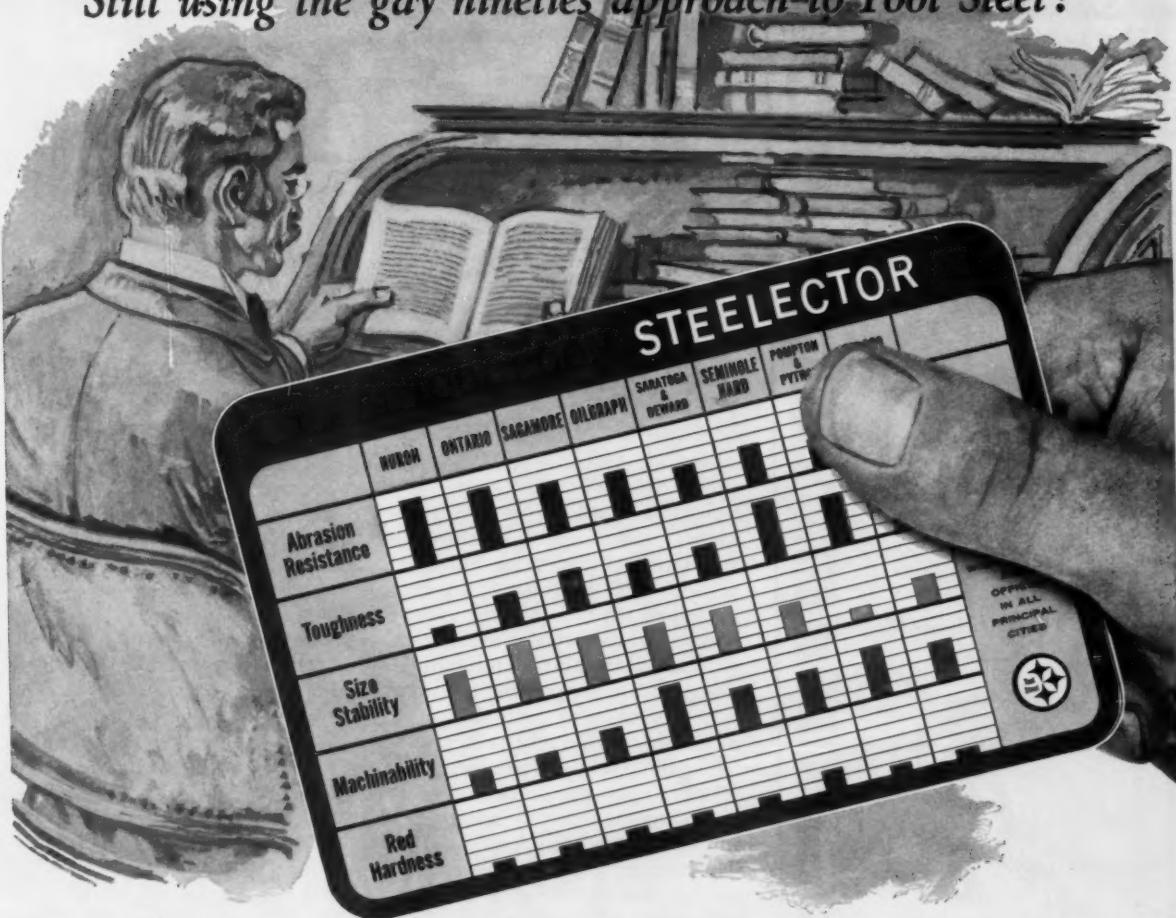
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City..... State.....

### Die-Casting Machine

The Cleveland Automatic Machine Co., Cincinnati, Ohio, is now offering an entirely new design of their Model 100 die-casting machine. This machine has strain-gage-tested locking pressure of better than 100 tons, and is avail-

*Still using the gay nineties approach-to Tool Steel?*



## Use the New, Modern A-L Steelector System

Now you can accurately select the proper tool steel based on its individual characteristics and be sure that it's available for off-the-shelf delivery before you place your order.

The new Allegheny Ludlum STEELECTOR Program makes tool steel selection fast. And it eliminates the embarrassment of specifying a grade which later turns out to be unavailable or available only after a costly delay.

The leading grades of tool steel that meet 96 percent of all applications—as listed in the Allegheny Ludlum Tool Steel Handbook—form the basis of the STEELECTOR Program. The STEELECTOR Grades are charted on cards covering each group of steels (tool room, hot work, and high speed grades) to help you select the particular grade best for your application.

Bar graphs on each STEELECTOR Card show how the various grades compare in abrasion resistance, toughness,

size stability, machinability and red hardness. It's easy to determine accurately the combination of properties that best suits the job at hand.

The complete necessary range of sizes and shapes is listed in a special Data Stock List for every grade. These lists also include heat treating, typical working hardnesses and other data to insure that your selection is correct.

You can choose with confidence because every STEELECTOR grade has been selected from the complete line of Allegheny Ludlum Tool Steel and made under the rigid quality control standards of all A-L products.

For a complete explanation of the STEELECTOR Program, ask your Allegheny Ludlum sales representative for a copy of the colorful A-L Tool Steel STEELECTOR Booklet, or write: *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. M-11.*



**ALLEGHENY LUDLUM**  
Tool Steel warehouse stocks throughout the country



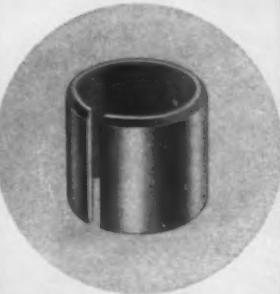
# GILLENN

EVERY TYPE OF KEYING AND PINNING DEVICE FOR PRODUCTION ASSEMBLING

*Eliminate expensive  
machining and fitting  
with*

## NEW GILLENN Hardened Spring Steel **TENSION BUSHES**

Self-Seating • Self-Fitting  
Long Wearing • Economical



STRAIGHT SLOT



ARROW SLOT



SLANTED SLOT

### Internal or External Types

Many lengths and diameters.  
Chamfered for  
Quick and Easy Insertion.

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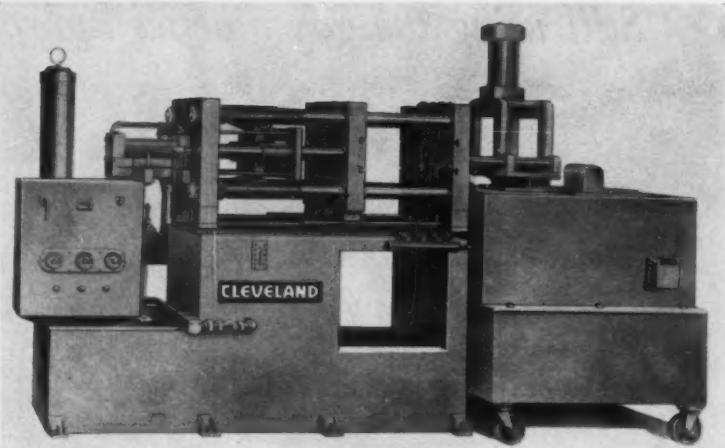
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**GILLENN**

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PIVOTS • BUSHES • TENSION, TAPER, GROOVE & DOWEL PINS • MACHINE KEYS & PARTS



Model 100 die-casting machine announced by Cleveland Automatic Machine Co.

able as a standard, or fully automated, hot-chamber machine; a standard cold-chamber machine; or a cold-chamber machine equipped with the Morton system of vacuum die evacuation, with or without automatic aluminum ladling. It is equipped for accumulator operation of both shot- and die-closing cylinders, and cycles well over 1000 shots per hour, depending upon size and complexity of casting, the metal being cast, and the method of operation. The shot capacity is 2.6 pounds of aluminum and 4.2 pounds of zinc with standard plungers (other capacities with other size plungers).

The machine has 22- by 23-inch die plates and can accommodate dies of 19-inch maximum and 4-inch minimum thickness. Platens are 3 3/4 inches thick and tie-bars are 2 1/2 inches in diameter. Model 100 is equipped with a 15-hp motor, driving a pump having a capacity of 22 gpm at 1000 psi. A 60-gallon, hydraulic fluid reservoir and a 7 1/2-gallon-capacity piston type accumulator are provided. The toggle mechanism is located in the horizontal plane for greater accessibility and the main control panel is mounted at the pump end of the machine with conveniently located push buttons.

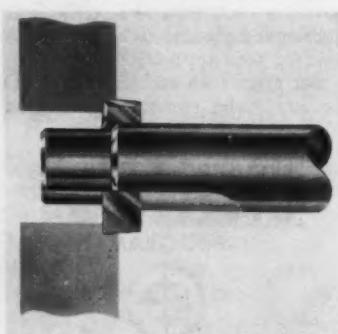
Among new features incorporated in the design of the Model 100 die-casting machine is the furnace, which is mounted on casters so that it can be rolled away from the machine to remove the pot from the furnace. In the operating position, locks on the casters prevent movement of the furnace.

Space has been provided through the base of the machine to insert a single unit conveyor and water quench box, which, when castings are ejected, will quench the casting and deliver it to a bin or other conveyor located at the pump end of the machine. The conveyor and water box are of unit construction and can be rolled under the bed of the machine and lagged to the floor by bolting. Other optional equipment available includes a stripper for removing the casting from the die, low-pressure die closing, and automatic die and machine lubrication. For hot- or cold-chamber casting the machine is designed to permit two-position shot injection.

Circle 604 on Readers' Service Card

### Super-Centric Spot-Facing and Counterboring Tools

Adjustable cutters designed to provide unusual accuracy for counterboring and spot-facing operations in a wide range of diam-



MACHINERY, November, 1960

# INTERVIEW

## MODEL III

KEARNEY & TRECKER  
**MILWAUKEE-MATIC**

### WITH THE **AUTOMATIC TOOL CHANGER**

that on tape command can automatically select and change large tools in 15 seconds. Exclusive tool coding system provides for the possible, random, error-free selection of 961 different tools from the rotary tool storage magazine.



This new, time-slashing, profit-producing MODEL III extends the *Manufacturing with MILWAUKEE-MATIC CONCEPT* to larger workpieces . . . combines high horsepower with high precision.

" . . . almost human — only better — it doesn't make mistakes" . . . "I see it, but I still don't believe it" — were typical of the comments made by experienced machine tool buyers, on seeing this pace-setting MODEL III in action here at the birthplace of the *Manufacturing with MILWAUKEE-MATIC CONCEPT*.

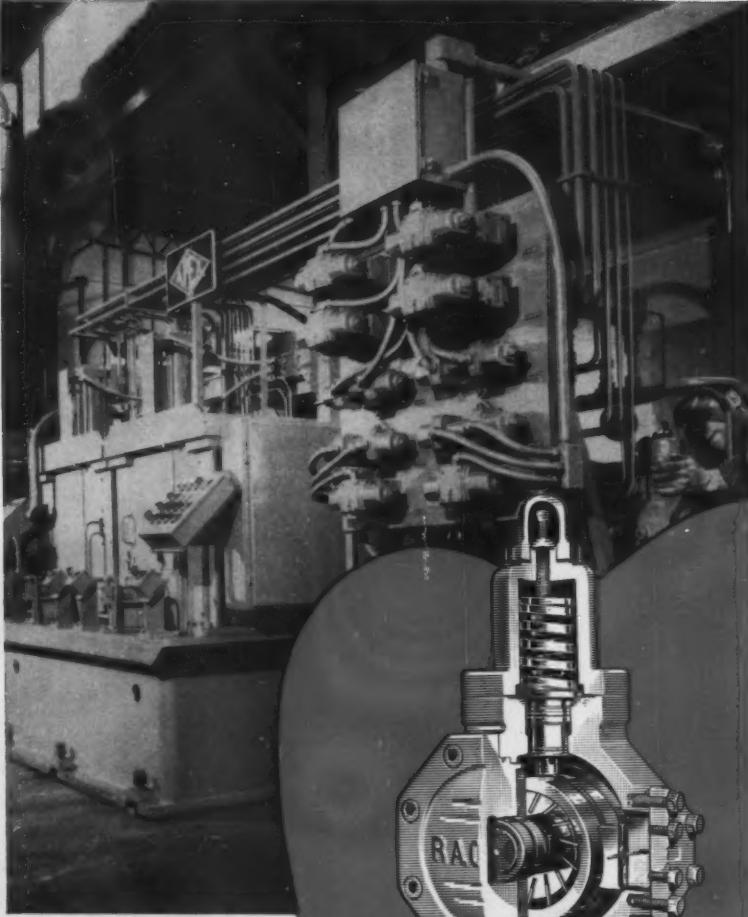
Write or call for complete information on this new addition to the MILWAUKEE-MATIC family.

Numerical Control Division



**KEARNEY & TRECKER CORP.**  
6800 W. NATIONAL AVE. • MILWAUKEE 14, WIS.  
(Phone Greenfield 6-3300... Direct Distance Dialing Code 414)

Longitudinal ("X"-axis) Travel Range ..... 44 inches  
Vertical ("Y"-axis) Travel Range ..... 34 inches  
Depth ("Z"-axis) Travel Range ..... 32 inches  
Work Pallets—Surface Area ..... 28" x 36"  
Automatic Index Table—to any of 360-1 positions . . . at 5 rpm  
Rotary Tool Storage Magazine ..... 30 tools capacity,  
plus one tool in spindle  
Max. Tool Dia. Automatically Changer ..... 6 inches  
Tools can be added to, or removed from any position in the magazine  
at any time.



BUILT BY APEX CORP.,  
ROSEVILLE, MICHIGAN

## This active hydraulic heart helps

SEAL POROSITY IN 106 TRANS.  
MISSION CASES EVERY HOUR

A RACINE VARIABLE VOLUME PUMP and 10 RACINE VALVES control all mechanical operations in this Apex impregnating machine, which seals leaky transmission cases at a major auto firm's transmission plant in Toledo, Ohio. Apex specified RACINE equipment because its design simplifies machine design problems . . . eliminates the need for extra pumps and valves. RACINE PUMPS are easy-to-control . . . handle pressure compensation automatically for varying gpm requirements. Apex has preferred RACINE for over 10 years!



*the HEART of this  
impregnating machine  
is a RACINE*

MODEL 6FA PUMP



Racine Hydraulics & Machinery, Inc.  
RACINE, WISCONSIN  
HYDRAULICS DIVISION

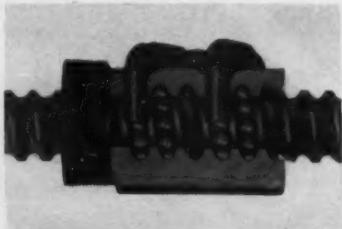
eters announced by Muskegon Tool Industries, Inc., Muskegon, Mich. These Super-Centric counterboring and spot-facing tools will provide perfectly true counterbores, with complete control of size, finish, and concentricity in virtually any material, according to the manufacturer. They feature special grinds to eliminate deflection caused by difficult angles or imperfect diameters of the original holes in counterboring, and to assure complete accuracy in spot-facing operations. They are fully adjustable for a wide range of diameters and can be readily reground many times to assure maximum tool life. These tools can be used singly or in multiple subland combinations on turret lathes, bar automatics, chucking machines, boring mills, vertical turret lathes, or radial drills. Equally adaptable for back counterboring and back spot-facing operations, they are available in a full range of sizes in high-speed steel or with carbide tips for any application.

Circle 605 on Readers' Service Card

### Low-Cost Ball Screws and Splines

An economy line of standard ball-screw and ball-spline assemblies is now being offered in a range of sizes by Beaver Precision Products, Inc., Clawson, Mich. The extreme positioning accuracy accomplished with the firm's ground-thread specials is sacrificed in the new standard assemblies, and solid preloading is impractical due to the lower tolerances. Applications lie principally in the moving of loads with low break-away friction, minimum space requirements, and low service requirements resulting from minimized friction and wear.

Circle 606 on Readers' Service Card





EXCLUSIVE  
COAXIAL  
SPINDLE  
DESIGN

new proven design  
**Nebel**  
**MICRO-TURN\***  
HIGH-SPEED PRECISION LATHE



\*TM

The entirely new Nebel MICRO-TURN Lathe combines the convenience of infinitely variable spindle speeds with the high efficiency of an exclusive new coaxial spindle. Designed around a single shaft surrounded by a planetary gear arrangement, the headstock provides outstanding structural benefits:

- Low Inertia Effect for quicker acceleration and deceleration, prolonging clutch and brake life
- Simplified Alignment with fewer revolving parts for greater smoothness and efficiency of power transmission

The MICRO-TURN Headstock is composed basically of two sections. The compact back gear unit provides high reduction in minimum space, operates only on low speed range and presents maximum power at the spindle for rated horsepower up to 400 RPM. Above 400 RPM, the coaxial spindle sections lock into a single unit, reducing vibration and insuring a high degree of finish.

For complete details, write today for your copy of the new MICRO-TURN Bulletin No. 219. Nebel Machine Tool Corporation, Lathe Division, 3410 Central Parkway, Cincinnati 25, Ohio.

*Hardened, Tempered and  
Ground-from-the-Solid!*



*It pays to specify*

## ACE DRILLS REAMERS BLANKS

Premium Quality  
High Speed Steel,  
Solid Carbide and  
Carbide Tipped.



### ACE DRILL SETS

Standard stock sets include Fractional, Wire and Letter size drills, packaged in convenient folding index cases.

### ACE BLANK SETS

Uniformly hardened high speed steel reamer and drill blanks precision ground to new close tolerance limits available in standard Fractional, Wire and Letter series sets.

Call your local distributor today—or write Ace direct for latest catalog and price information.



**ACE DRILL**  
Adrian, Michigan

ORIGINATORS OF "GROUND-FROM-THE-SOLID" DRILLS  
Circle this page number on card

### Tape-Controlled, Eight-Spindle Turret Machine

A Model 3BHT-B tape-controlled, eight-spindle turret drilling, tapping, and boring machine

ing costs by eliminating box fixtures and jigs. This new bench-model automatic, six-spindle turret

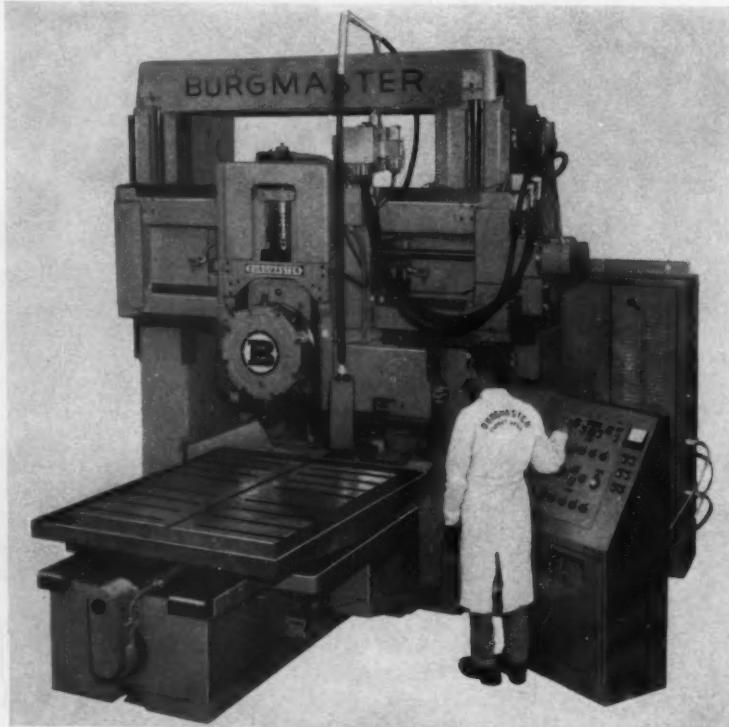
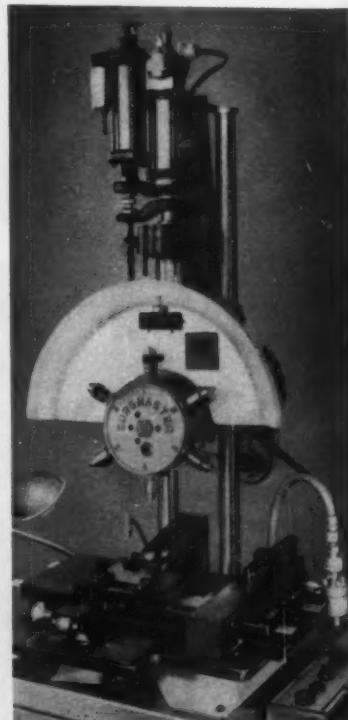


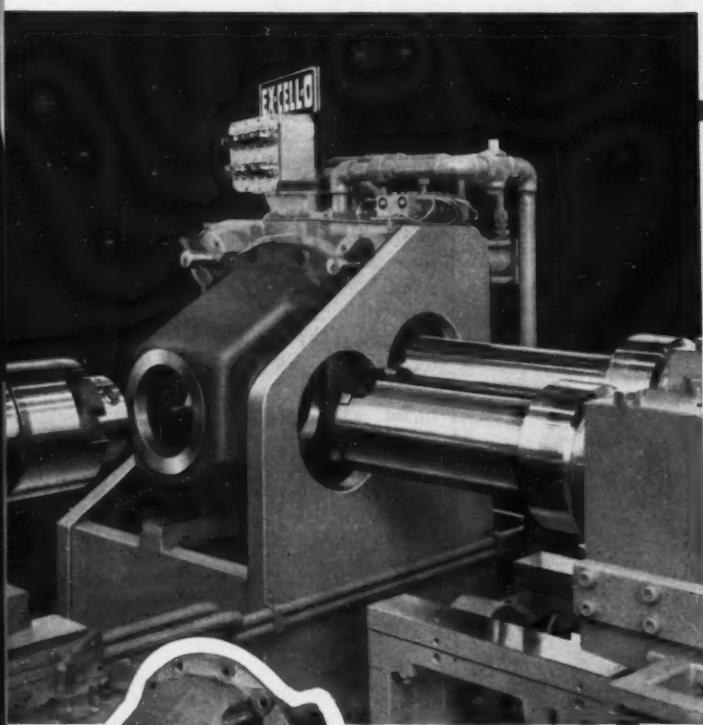
Fig. 1. (Above) Burgmaster Model 3BHT-B tape-controlled, eight-spindle turret machine. Fig. 2. (Below) Bench-model automatic, six-spindle turret drill

of double-housing planer type design (Fig. 1) was introduced at the Chicago Machine Tool Exposition by the Burgmaster Corporation, Gardena, Calif. This machine provides X-Y axis table-positioning capacity of 48 by 60 inches, and vertical clearance of the spindle nose over the table of 39 inches with the bridge up. The turret feeds 12 inches independently of the bridge at any point from 39 to 3 inches above the table. Machining is fully automatic for such operations as drilling, reaming, tapping, boring, counterboring, spot-facing, porting, etc. Hole locations can be held within plus or minus 0.001 inch total at any point on the table, and positions are repeatable within plus or minus 0.0005 inch.

Another machine recently introduced by the Burgmaster Corporation offers a combination unit that speeds precision drilling operations and greatly reduces tool-



# Ex-Cell-O Custom Machines Specialize in Difficult Jobs!



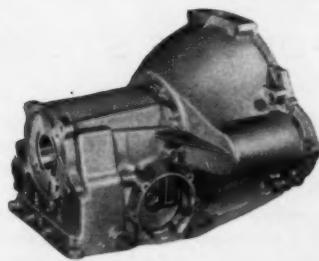
Whether you have a simple job that must be done faster and more accurately, or complex work that requires multiple machining operations, an Ex-Cell-O Custom Machine may be just the answer you've been looking for . . . the economical solution to a difficult production problem.

See your Ex-Cell-O Representative, or contact Ex-Cell-O's Machinery Division in Detroit for details on the limitless applications of Ex-Cell-O Custom Machines.

◀ **HEAVY-DUTY BORING**—Custom Boring Machine uses three heavy-duty Ex-Cell-O Precision Spindles to simultaneously finish-bore four holes and bore-and-face a fifth hole in this 75-pound cast-iron housing in a 4½ minute cycle. Diameters are about 6"; tolerances are held within .001".



**MULTI-DIAMETER BORING**—In a single cycle, the long boring bar on this Custom Machine line-bores two holes while shorter bar below it bores a third diameter, and small spindle in foreground bores a dowel hole in this huge clutch and gear housing.



**HIGH PRODUCTION**—Aluminum transmission case shown above is turned 90°, rolled over 180° as it passes through a 24-station Custom Machine. Automatic operations include precision boring, facing, chamfering, radial milling, tapping, trepanning, air gaging and flushing. Output is 124 parts per hour.

**EX-CELL-O FOR PRECISION**

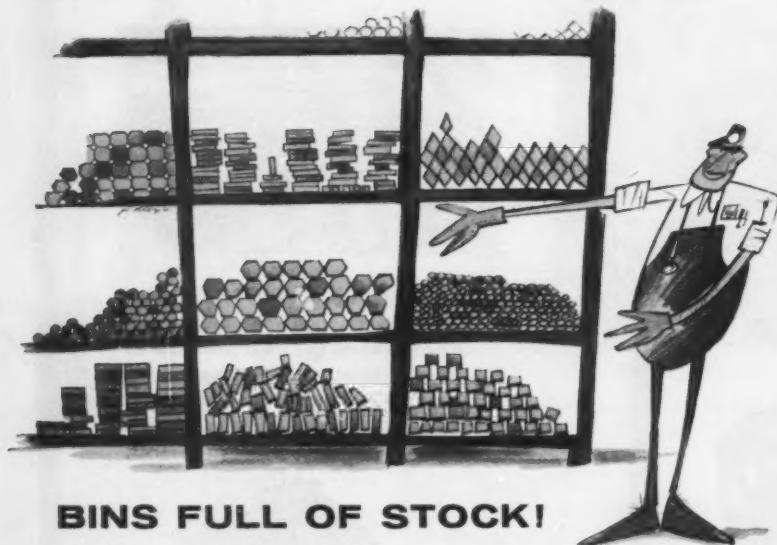
MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS  
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LOVEJOY  
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drill (Fig. 2) with power feed is synchronized to the controls of an accessory manual positioning table which rapidly locates each hole center within 0.0005 inch, and is said to materially increase production. The turret drill is used for such operations as drilling, reaming, tapping, etc.

The free-floating table is mounted on ball bearings, permitting rapid and effortless positioning. A pointer over a template of the hole pattern quickly guides the operator to each position. By releasing a thumb button on the operating handle, an air-operated shot pin locks into the master pattern and simultaneously initiates the automatic feed stroke of the turret. The turret returns to "top stop" and, at the next table position, repeats without indexing unless cycled by the operator's push button on the side-mounted control panel.

The machine controls permit three types of operations: (1) manual—operation with power feed; (2) semiautomatic—cycles through a predetermined set of operations, loading and unloading manually; and (3) fully automatic—cycles automatically using shuttle tables, index-tables, hopper feeds, etc. The unitized control panel provides a function selector with "Off," "Manual" and "Automatic," and with separate "Start" and "Emergency Up" buttons. The six-spindle turret drill and tap capacity is 1/4 inch in steel. Working area of the table is 4 inches front to back and 5 inches right to left.

Circle 607 on Readers' Service Card

### Side-Etched Gage-Blocks

DoAll Co., Des Plaines, Ill., announces that its rectangular gage-blocks, 0.050 inch and larger, are now etched on the side and clearly



# BAUSH "SPECIAL" 3-WAY UNIT

DRILLS, ROUGHS, AND FINISH FORMS  
SPARK PLUG HOLES IN CYLINDER HEAD —

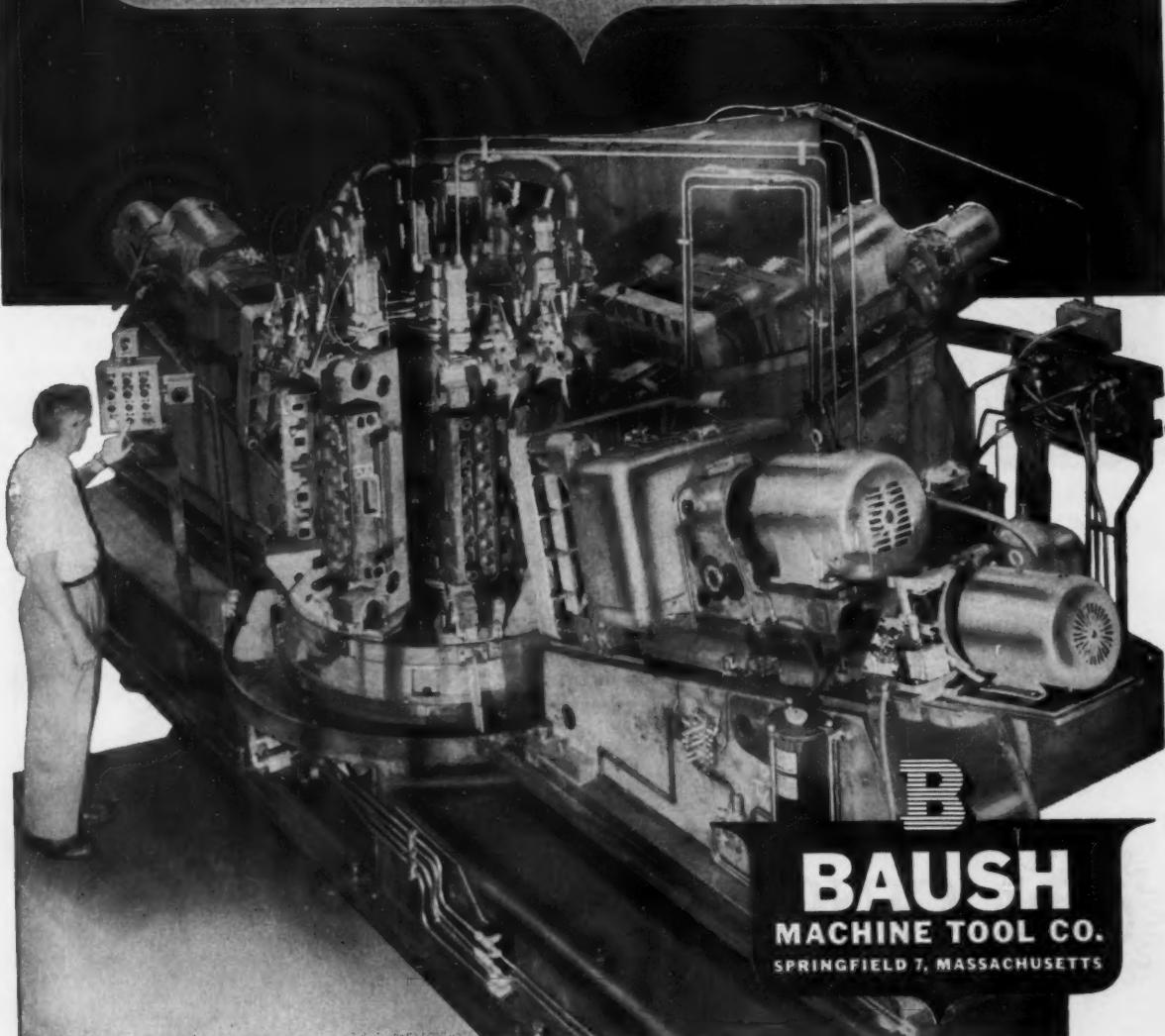
It is one of several different machines we have designed and are producing to complete a cylinder-head production line for a leading automotive manufacturer . . . resulting from past proven performance of other Baush units designed for specific jobs in this plant.

If you are thinking of AUTOMATION — THINK OF BAUSH. Our experience is yours — we'll gladly help with your machine tool problems.

## SPECIFICATIONS:

Unit has 50" diameter, 4-station semi-automatic rotary table with a 2-position, 4-station fixture, plus full Trabon Lubrication. Three (3) 35° Vertical Angular Model "S" Mechanical Leadscrew units, each having a 4-spindle fixed center head, are mounted on a welded steel center base. Chip conveyor runs through machine.

Part is manually loaded into fixture and hydraulically located and clamped. Fixtures are equipped with guide bushing for tools and bars register in holding units when part is in machining position.



**BAUSH**  
MACHINE TOOL CO.  
SPRINGFIELD 7, MASSACHUSETTS

# Whatever the product...

only "custom" gears and  
gear boxes really  
do the job!



Don't let adaptation and compromise determine your gearing specifications. Custom-made gears and gear boxes from Cincinnati Gear are competitively priced—yet, they afford the design engineer full freedom to incorporate the exact transmission components he requires to suit his specific need.

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Custom Gear Makers Since 1907

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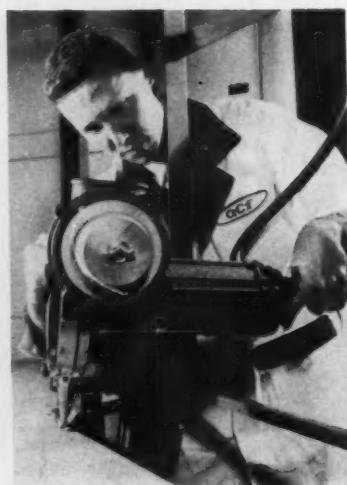
visible while stacked. This improvement applies to both the standard and new stainless-steel blocks. Boxes for these new blocks have been designed to take full advantage of the side-etching feature. Now sizes are easily visible, whether the blocks are in the box or removed. Individual block dimensions can be seen at all times, and the total dimension of a combination is easily determined. This is particularly useful when using "Go" and "Not-Go" stacks. With side etching, the problem of identifying the stacks is eliminated.

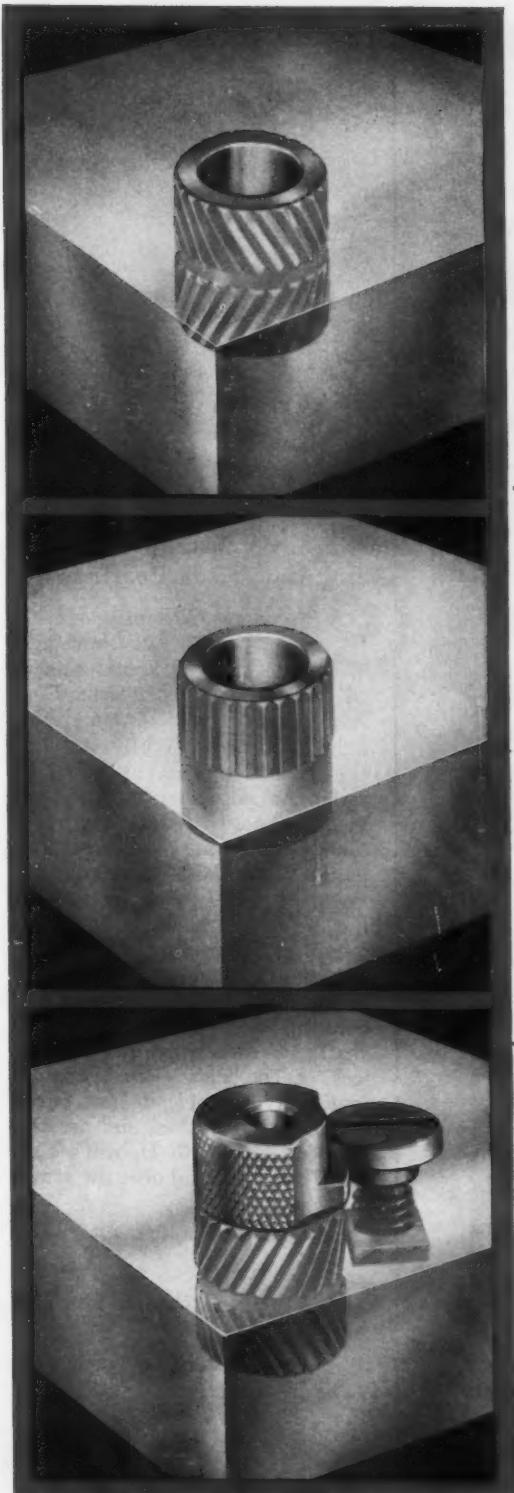
Circle 608 on Readers' Service Card

## Portable Punch Riveter

A 1/8-inch riveting machine that is said to operate eleven times as fast as existing methods has been unveiled by the electronics division of ACF Industries, Inc., Riverdale, Md. The device, described as the world's first portable punch riveter, is the division's newest product in its line of Erco machine tools. It performs all operations automatically—in less than two seconds—punching the hole, placing the rivet, and heading it. Weight of the riveter is 50 pounds. It is furnished with a cable type balancer for overhead suspension and it is constructed so that it also can be permanently installed on a work-bench. Of pneumatic-squeeze design, action is controlled by a finger trigger and a hand grip.

Circle 609 on Readers' Service Card





# NOW in STOCK for Immediate Delivery...

## Ex-Cell-O Drill Jig Bushings for All Plastic Tooling Jobs!

### FOR 'POTTING' ...

Ex-Cell-O Trans-Lok Bushings have exclusive herringbone knurl and annular groove design for maximum security in potted-type jigs, fixtures and templets. Bushings can't twist or pull out.

### FOR PRESSING ...

Ex-Cell-O Press-Lok Bushings have straight knurls for greater gripping power when pressed into plastic, wood or other ductile materials.

### FOR RENEWABLE BUSHINGS, TOO ...

Ex-Cell-O Trans-Lok Liners, with the same deep transverse ridges as Trans-Lok Bushings, permit drilling or reaming using standard fixed-renewable or slip-renewable bushings.

Made of high chrome, high carbon oil-hardening bearing steel, Ex-Cell-O Bushings for plastics have uniform hardness, 62-64 Rockwell C precision ground diameters, and conform to A.S.A. standards and Ex-Cell-O's own high standards for quality.

Send today for catalogs covering Ex-Cell-O's complete line of bushings for plastics and metal or order direct from stocks in Detroit or Downey, Cal.

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#### Precision Parts Division

**EX-CELL-O**  
CORPORATION  
DETROIT 32, MICHIGAN

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OA Lengths	4" to 120" with dia. limits	10", 16", 22", 36"	16", 22", 36"
Drivers	Std. or to fit your need	.750" dia. x 2 1/4" long	1" dia. x 2 1/4" long
Tips	Carbide	Carbide	Carbide

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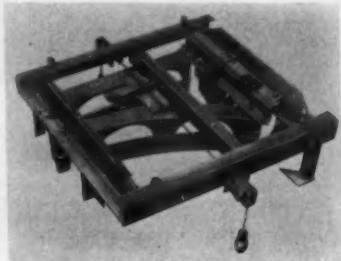
### Hoover Narrow-Width Pillow-Block Bearings

A line of compact pillow-block bearings which utilizes housings of ductile material is announced by the Hoover Ball & Bearing Co., Ann Arbor, Mich. Designed for light- and medium-duty service, the line is designated as the EDX series. An improved lip type seal maintains positive contact with the inner bearing ring at all times, regardless of shaft misalignment. Factory-applied lubricant lasts for the life of the bearing. Both pillow-block bearings and FEDX companion flange bearings utilize an eccentric locking collar to secure the inner bearing ring to the shaft. A set-screw assures positive locking. The bearings are available in a wide range of shaft sizes, from 1/2 to 1 3/16 inches, and are interchangeable with Hoover's ED and FED units, and offer the same load capacity.

Circle 610 on Readers' Service Card

### Roller-Gliding Overhead Track Switches

The Cleveland Tramrail Division



MACHINERY'S  
HANDBOOK

NEW  
16<sup>TH</sup>  
EDITION

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# MACHINERY'S HANDBOOK

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THE BIBLE OF THE MECHANICAL INDUSTRIES

THE 16<sup>TH</sup> EDITION



INDUSTRIAL PRESS

because of different  
alloys plus different  
metals. The two  
most specific  
models have a tensile  
strength of 477 given  
above room  
temperature and reaches zero

296

Table 1 (Continued). Algebraic Solution of Force Systems — A1  
in the Same Plane

Finding the Resultant of Forces Not Intersecting at a Common  
Point

1. Draw a set of  $x$  and  $y$  coordinate axes through any convenient point  $O$  of the forces as shown in the diagram.
2. Determine the  $x$  and  $y$  coordinates of each force and the angle of action measured with  $2\pi$ ,  $\pi$ , and  $0$  as shown in the system.
3. Calculate the  $x$  and  $y$  components about  $O$ . If the moments are negative, change the sign of the components as negative below for a system of clockwise moments.

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 $F_{152}$   
 $x$   
 $y$   
 $z$

Coordinates of  
 $F_{153}$   
 $x$   
 $y$   
 $z$

Coordinates of  
 $F_{154}$   
 $x$   
 $y$   
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Coordinates of  
 $F_{155}$   
 $x$   
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Coordinates of  
 $F_{156}$   
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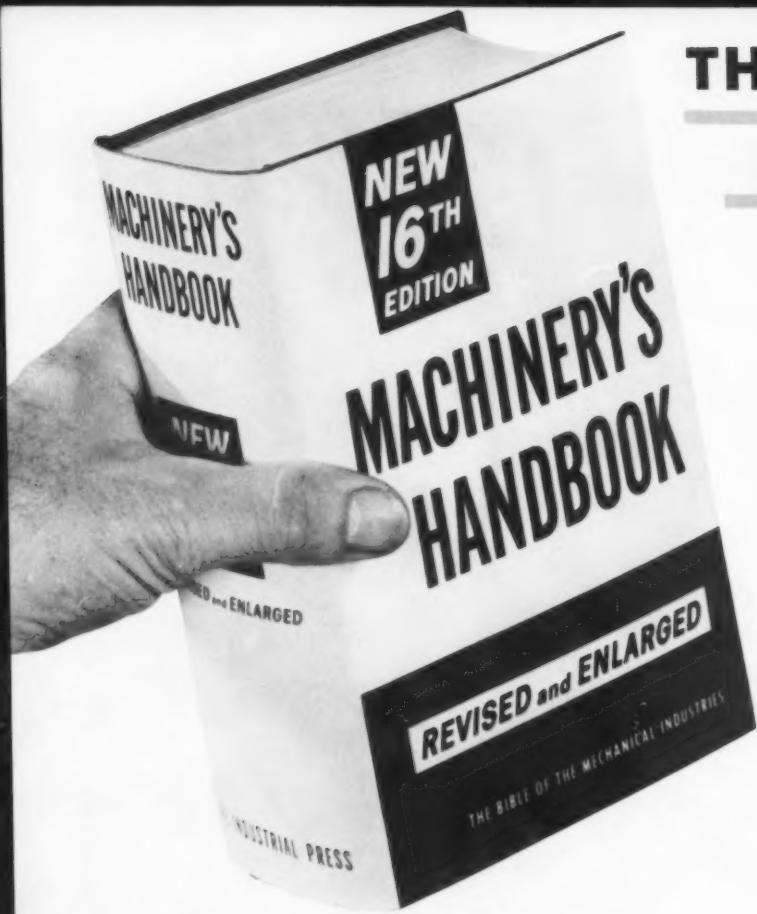
Coordinates of  
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Coordinates of  
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Coordinates of  
 $F_{159}$   
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Coordinates of  
 $F_{160}$   
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Coordinates of  
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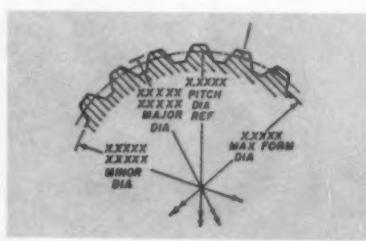


Since the publication of the 15th Edition of MACHINERY'S HANDBOOK, widespread time-saving and money-saving advances in metalworking technologies, techniques and standards have taken place. Here are just some of the topics that have been added to the 16th Edition to help you keep abreast of the changes and developments in the ever-progressing metalworking industry. Only a NEW Handbook can meet the needs of today's designing and metalworking jobs . . . help you move up to a better, more responsible position in your industry.

**SCREW THREAD SYSTEMS.** Probably the most widely used section in the Handbook, it has been completely revised to reflect the latest changes in screw thread standards. Contains dimensional data for all classes of Unified threads including the several new thread series recently added. The extensive tabular data and detailed discussion of Unified threads are useful to both the machinist and the designer. These tables present data for new Unified thread series and include hole sizes for tapping Unified threads based on the new minor diameter tolerances. Data are given for the manufacture and specification of Unified threads, the new Unified miniature screw threads, new dimensions for interference fit threads (studs), Acme screw threads, Stub Acme screw threads, and microscope threads. Complete diagrams for each of these threads show the disposition of allowances, tolerances and crest clearances.

**GEARING.** The subject of gearing has always been given careful attention in MACHINERY'S HANDBOOK. Advances in fine-pitch precision gearing called for the inclusion of this kind of detailed information: enlarged spur and helical gears from 7 teeth up, composite error inspection, checking pressures, indicator limits, angular position errors, angular backlash, and a complete tabular descrip-

tion of data for specification on drawings. . . . This is the first handbook to give the exact formula and tables of data for the selection of helical gear milling cutters in the production of milled gears for experimental and replacement purposes.



**INVOLUTE SPLINES AND SERRATIONS.** The widespread use of involute splines and serrations in place of straight splines has necessitated a new 43-page section giving complete design data, formulas, and dimensions in tabular form for the design, production, and specification of the various types of involute splines and serrations. As an aid to the draftsman, several pages are devoted exclusively to detailed drawing specifications for the various types of spline and

## THE 16<sup>TH</sup> EDITION ON THESE AND

serration fits. Tables of wire sizes and wire measurement data for involute splines and involute serrations are also included. The effect of spline errors on spline fits, error allowances and tolerances, and machining data pertaining to splines are also clearly explained and illustrated.

**TWIST DRILLS.** Included in this section are data on combined drills and countersinks, jobbers length millimeter drills, and other new data from the revised American Standard for twist drills.

**PHYSICAL PROPERTIES OF STEELS.** Heat-treated steels have been found to have the same tensile and yield strengths regardless of composition and alloying elements so long as they have been fully hardened to the same as-quenched hardness. Charts make it possible to determine expected tensile strength, reduction in area, yield points, and tempering temperature if the hardness of a particular steel is known. Strength data for a wide range of ferrous and non-ferrous metals are also given.

**BALL, ROLLER, AND NEEDLE BEARINGS.** This 72-page section gives standard description and dimensional data for all types of ball, roller and needle bearings. Besides dimensional and tolerance data for inch and metric bearings, there are data pertaining to shaft and housing fits, clamping and retaining methods, bearing life, radial and thrust load ratings, selection procedure for ball and roller bearings, equipment loads, bearing capacity, and bearing lubrication.



**TAPS AND THREADING DIES.** New designations, applicable to ground thread taps, have been added to this section which includes dimensions of all types of taps and dies. Recommended tap limits to achieve the various classes of fits in the Unified thread series are also included.

**TAP DRILLS.** Complete dimensional data have been included on drilled holes for Unified and Unified miniature internal threads, as well as for the old American Standard thread classes.

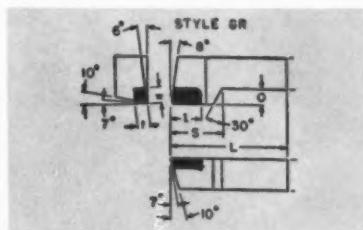
**KNURLING AND KNURLING TOOLS.** Complete data concerning the diametral pitch knurls recommended as providing good tracking by the American Standard are presented. Includes tolerances for work diameters before and after knurling.

**CARBIDE BORING TOOLS.** Standard data for solid and tipped carbide boring tools, as published in the latest American Standard, have been included because boring tools differ in many respects from other single-point cutting tools.

**FLAT BELTS.** The continuing popularity of flat belts in certain applications has been given consideration in 16 new pages, complete with diagrams for cutting, lacing and installation of these belts.

# GIVES YOU THE LATEST DATA OTHER IMPORTANT SUBJECTS!

**SINGLE-POINT CUTTING TOOLS.** Added to this section are data on solid carbide inserts and their holders, with complete dimensions for each. These are the carbide cutting tools included in the latest American Standard.



**SELF-TAPPING SCREWS.** Data on drills and punched holes for self-tapping screws and the application of the various types of screws are presented.

**TAPERS.** Data on Morse stub taper shanks have been added to the already extensive taper-shank section of the Handbook.

**SCREW THREAD INSERTS.** Screw thread inserts including the self-tapping type are now widely used to achieve strong threads in soft materials, as well as for replacement of stripped threads.

**TAPER PINS.** To facilitate the machining of taper holes for taper pins a new chart has been provided showing drill sizes for step drilling prior to taper reaming.

**GROOVED PINS.** Dimensions of standard grooved pins have been given.

**BOLTS, SCREWS, NUTS, WASHERS.** Among the changes in this section are new American Standard dimensions for plain washers and toothed lock washers and clearances for box, open-end, and socket wrenches.

**GRINDING, POLISHING, AND LAPPING.** This new 54-page section provides the latest in available data, techniques, and process descriptions in connection with grinding wheels, wheel dressing, centerless, surface-, cylindrical, offhand, and portable-grinding. Tables of grinding troubles give recommendations for their correction. Descriptive data facilitate the selection of proper grinding wheels.

**METAL JOINING, CUTTING AND SURFACING.** This completely new 36-page section deals with soldering, brazing, hard facing, welding, flame cutting, arc-cutting, etc. In addition to detailed descriptions of each of these processes, convenient tables aid in the selection of the best process for the operation at hand. Explains brazing of high-speed steel tips to carbon steel shanks.

**V-BELTS AND SHEAVES.** The increasing use of V-belt drives is reflected in the new 17-page section dealing with such topics as: light-duty drives, belt cross-sections, sheave dimensions, horsepower ratings, multiple V-belts, V-belt installa-

tion, service factors, operating speeds, idlers, V-flat drives, double-angle V-belts, and selection procedure.

**TRANSMISSION CHAINS.** A section of 41 pages provides coverage of transmission roller chains and silent chains. Discussed are: sprockets, chain parts, keys, keyways, set-screws, center distance between sprockets, length of chain, cutting sprocket tooth form, sprocket materials, cutters for sprocket teeth, horsepower ratings, design procedure, chain designations and dimensions, drive ratios, chain selection, etc.

**FLYWHEELS.** Because the flywheel is so important as a source of energy for punching, shearing and other shop operations as well as a means of providing a uniform flow of energy in rotating engines, new data pertaining to the design of flywheels are given. This takes account of centrifugal stresses, combined stresses, and residual stresses. Of primary importance are the two up-to-date tables of safe speeds for flywheels in accordance with American Standard and insurance company requirements.

**STRENGTH OF MATERIALS.** The data given on the strength of materials, or mechanics of materials, take the guess-work out of determining the most economical size and shape of machine parts or structures to meet strength and deflection requirements. In addition to formulas and data that apply to straight beams and columns, new sections have been added, giving formulas and tables for curved beams such as are used in machine frames; pipe columns; round, rectangular, and square plates; cylinders subjected to internal and external pressure; tubes, and shells.

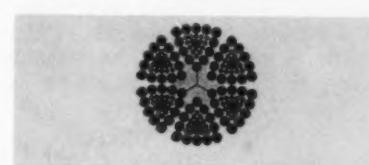
**SHAFTS.** Formulas and directly applicable tables for strength and horsepower capacity, as well as considerations of torsional and linear deflection for various conditions of loading, are given in detail. Included are formulas for critical speeds of rotating shafts, formulas for shafts of brittle materials, and data for the effect of keyways on shaft strength.

**STANDARDS.** Data and information from the latest American Standards have been included, wherever possible throughout the wide range of Handbook topics. Comparable data and information from a large number of British Standards have also been given to provide a reliable reference on British practice.

**SPRINGS.** The data for designing and winding springs have been supplemented by a new section giving a detailed description of the most widely used spring materials, their strengths, moduli of elasticity, service factors for various applications, endurance limits, and working stresses at elevated temperatures.

**PLAIN BEARINGS.** A complete section on the factors to be considered in the design and selection of plain bearings, as well as a step-by-step procedure utilizing simple charts and formulas, has been provided as a guide for the designer. In addition to complete tables of alloys for both solid and sintered bearings, information on wood bearings, plastic laminate bearings, rubber bearings and others is given and the procedure for babbitting bearings in the shop is explained in detail.

**INVOLUTE FUNCTIONS.** Involute functions of angles have been established as the most convenient means for solving certain problems in gear design and measurement. A complete set of involute functions from 14 to 58 degrees in increments of one minute and to as many as seven decimal places is provided.



**WIRE ROPE.** Some of the topics covered in this new 17-page section are: installation, safe working loads, factors of safety, sizes, simplified practice recommendations, drum and reel capacities, maintenance, lubrication, replacement.

## The Use of Handbook Tables and Formulas

A Companion Book for Users of MACHINERY'S HANDBOOK which Shows You How to Get the Most out of Your Handbook.



The Use of Handbook Tables and Formulas throws the spotlight on essential timesaving tables, rules and general information in MACHINERY'S HANDBOOK that the ordinary user may never discover. Examples, solutions and test questions show typical applications of Handbook matter in both drafting-rooms and machine shops and enable the Handbook user, through practice, to obtain the required information quickly.

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over a million and a quarter copies have been sold! No wonder it has earned the reputation as "the bible of the mechanical industries"!

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the most suitable metal for his casting application. Included are heat treatment and machining data and numerous photographs of typical applications. For your free single copy see one of the Meehanite foundries listed below or write *Meehanite Metal Corporation, 714 North Avenue, New Rochelle, New York*.

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of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has put into production two overhead track switches designated as Types K and L. Designed for loads of 2000- to 4000- pound capacity, the switches are of steel construction, assembled in jigs to assure accuracy and permanency of alignment. Operation is easy because the inner track-carrying frame rides on antifriction rollers. A latch mechanism holds the switch firmly in position. Safety guards prevent carriers from running off open ends of incoming rails. The switches are made for left-hand, right-hand, and three-way operation; for manually operated and motor-propelled systems. They can be shifted by hand, electric or air power.

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**Push Type Welding Gun  
and Wire Feeder**

An air-cooled, push type welding gun and wire feeder for use with the gas-shielded metal-arc (Airco-matic) welding process is now available from Air Reduction Sales Co., New York City. The gun, Model AH60-B, has a 60-degree gooseneck nozzle assembly for welding in hard-to-reach places, and a lever type trigger for ease of operation. It can also be used with Buried arc welding and Sprayarc welding using carbon dioxide as a shielding gas. The wire feeder, Model AHF-D, has a remote control with 15 feet of service cord to provide speed adjustment up to 600 ipm. Operating on 115-volt, 60-cycle alternating current, the feeder can be used with either constant-arc voltage or Fillerarc motor-generator power sources.

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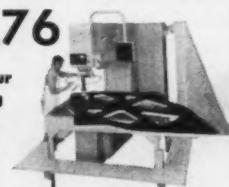
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Note some of the typical parts machined. Ask for illustrated literature giving further details and send samples of your work for a cost estimate on handling it on the Goss & De Leeuw.



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### Prehoned Disposable Carboloy Inserts

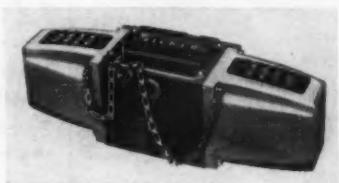
The Metallurgical Products Department, General Electric Co., Detroit, Mich., can now supply Carboloy (R) Pre-honed disposable inserts in any quantity and in most standard grades. Extensive tests in actual production are said to have shown that these inserts have about 35 per cent longer predictable tool life than un honed inserts and that they are substantially better than hand honed inserts. In addition, pre honing makes it possible to use harder, more durable grades. Grades formerly used only for finishing may be used in semifinishing when prehoned. Grades earmarked for semifinishing may be used in roughing. In both instances the results obtained have been satisfactory.

Prehoned inserts also cost less than un honed inserts plus hand honing. The prehoning process is mechanical and exact. All edges of each insert are honed to a uniform radius which varies according to the service. For semifinishing, a medium radius is used; and for roughing, a heavier radius is employed. Pre-honed inserts have been tested over a long period of time before being placed on the market.

Circle 613 on Readers' Service Card

### Four-Way Directional Control Valve Has Air-Cooled Solenoids

A solenoid-operated, four-way directional control valve has been announced by Vickers Incorporated, a division of Sperry Rand Corporation, Detroit, Mich. The unit offers unusual compactness and versatility for the many directional control requirements of hydraulic machinery. It has a nominal rating of 8 gpm and can handle flows up to 12 gpm without malfunction. Sub-plates are furnished with 3/8-inch ports, or with 1/2



## IN HYDRAULIC DESIGN

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**400 gpm @ 1250 psi • 275 gpm @ 3000 psi**

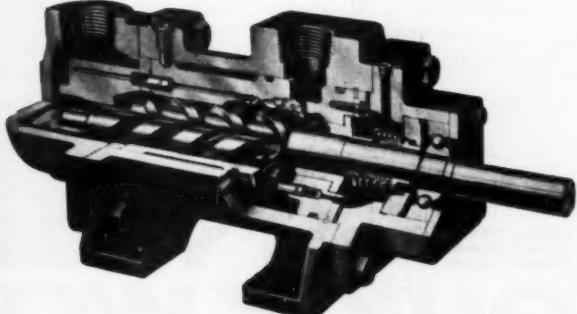
The De Laval IMO pump is unique. It may often replace two or more other type pumps in your design because of its high capacity. In the illustration shown here, the IMO pump is used to actuate a freight car unloader, designed by Straight Engineering Company. In addition to high capacities in a single pump, the IMO also gives you:

- Quiet operation—the proven pump for hydraulic elevators.
- High speed operation without sacrificing performance—ideal for 3500 and 1750 rpm motor speeds.

- Least pulsation of any rotary pump—ideal for machine tool applications.
- Dependable, long life operation—"the" pump for critical services on naval vessels.
- High suction lift capability—eliminates need for super-charging.
- Rugged design—nodular iron case utilized for pressures over 500 psi.
- Exceptionally high mechanical efficiency—means longer pump life.

The IMO has been time-tested and proven in the following applications: machine tools, presses, fan drives, pumping jacks, elevators, water level controls on dams, turbine governor controls, furnace controls, fire trucks—to rotate and raise ladders, and hydraulic systems for the U. S. Navy.

If you want more information on the versatile IMO pump, write for Bulletin 3200.



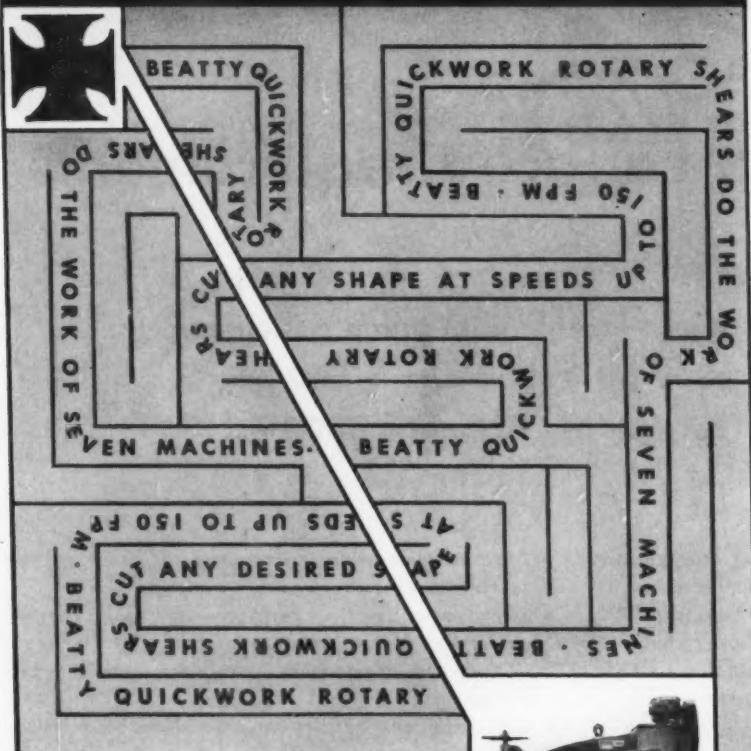
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**STEAM TURBINE COMPANY**

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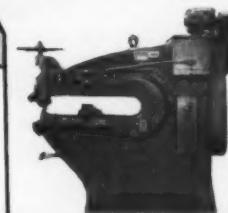
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A real cost saver for almost any type of metalworking shop, the Beatty Quickwork Rotary Shear does the job of seven machines. Its unique cutter design means greater speed, greater accuracy, greater ease of handling . . . all of which add up to greater economy. It's the proven way to cut costs of metal fabrication!

Write today for your copy of Bulletin No. BQ-100, and discover how Beatty Quickwork Rotary Shears can lead you through the maze of shearing costs!



### The FAST, ACCURATE way to . . .

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- CUT OPENINGS
- CUT ODD SHAPES
- CUT NARROW STRIPS
- CUT BEVELS
- CUT CIRCLES
- FORM FLANGES
- JOGGLE

# BEATTY QUICKWORK

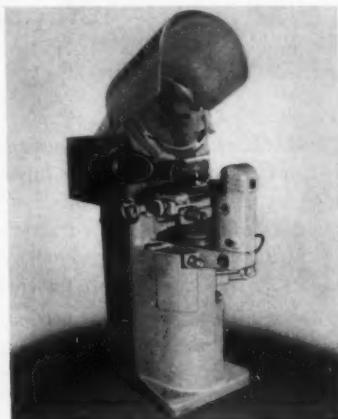
**Beatty Machine & Mfg. Co., & Quickwork Division**  
941 150th Street, Hammond, Indiana

inch ports to take advantage of the larger flows. Maximum recommended operating pressure is 3000 psi. The valve incorporates improved air-cooled solenoids which are retained in their cover rather than being mounted separately. In addition to quiet and cool operation, shock-free performance is assured through ample cushioning.

Circle 614 on Readers' Service Card

### Optical Comparator

Model PC-14A optical comparator being introduced by Jones & Lamson Machine Co., Springfield, Vt., has a 14-inch screen and in-



Fourteen-inch economy model universal measuring and comparison machine

corporates lateral-, and vertical- and angular-measuring facilities. Features include: direct-reading measurements to 0.0001 inch; high intensity, fan-cooled illuminating units; a full range of J&L Telecentric projection lenses from 5 to 125 $\times$ ; three table styles; and work capacity of either 5 or 8 inches in diameter with a maximum of 24 inches between centers.

Circle 615 on Readers' Service Card

### Zirconia Coating Applied by Plasmare Process

Zirconia ( $ZrO_2$ ) coating is now available for application by Linde's Plasmare plating process, according to an announcement by the Linde Company, division of Union Carbide Corporation, New



- New Grinding Features . . .
- New Grinding Efficiency

### The J & L Model E-2 Automatic Form Grinder with PERPETUAL FORM CONTROL through a full 12" width!

J & L's new Model E-2 Automatic Form Grinder offers a combination of features that add up to unprecedented production efficiency.

**Wide range of work speeds, from 50 to 1500 R. P. M.** New unitized headstock has a constant-speed AC motor, with fast cycling achieved by means of an electric clutch and brake. Proper surface speeds available for all diameters up to 8".

**Completely automatic cycle, with automatic positive size control.** High-speed approach, variable feed, spark-out and withdrawal are positively controlled through simple cam action.

Wheel slide is held against a positive stop with uniform hydraulic pressure.

**All kinds of wheel trueing, including PFC through 12" width.** All types of J & L diamond dressers are available. Also, crush dressing for wheels up to 4" in width. In cemented diamond particle cutters for continuous wheel forming, there are sensational new capacities up to 12" wide.

**Capacities up to 31", for precision shaft work.** Swivel-type platen up to 15°. Up to 31" between centers. Equally suitable for chuck work.

*For detailed information,  
write today for Form 5916.*

# JONES & LAMSON

Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont



MACHINE TOOL  
DIVISION

# ALLEN



**Allenpoint's deep, full-circle  
bite assures tremendous  
resistance to removal torque!  
Stays tighter longer!**

When you need a set screw that you can depend on to stay tight under heavy strain and vibrations, specify ALLENPOINT. Here's why you can always depend on ALLENPOINT: proper design of the cup diameter results in a rugged grip that makes the full-circle pattern you see here... deep, strong, clean sockets allow full wrenching leverage... and uniform Class 3A threads assure a tight friction lock over the entire length of Allenpoint Set Screws.

Ask your ALLEN Distributor for samples and full engineering details—he's always ready, willing, and able to give you prompt, practical service!

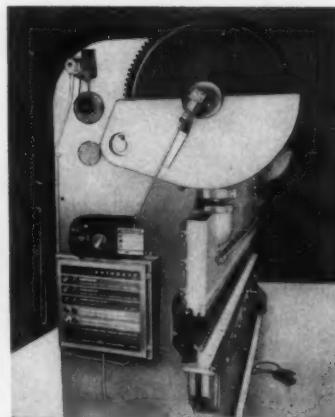


**ALLEN MANUFACTURING COMPANY**  
HARTFORD 1, CONNECTICUT, U.S.A.

York City. The coating will be used primarily for insulating purposes.

The Plasmarc process is a method for applying coatings and for fabricating shapes, using materials having ultrahigh melting points. In addition to the new zirconia coating, tungsten and other refractory metals have been applied to a number of different base materials, including graphite, steel, aluminum, brass, and molybdenum.

**Circle 616 on Readers' Service Card**



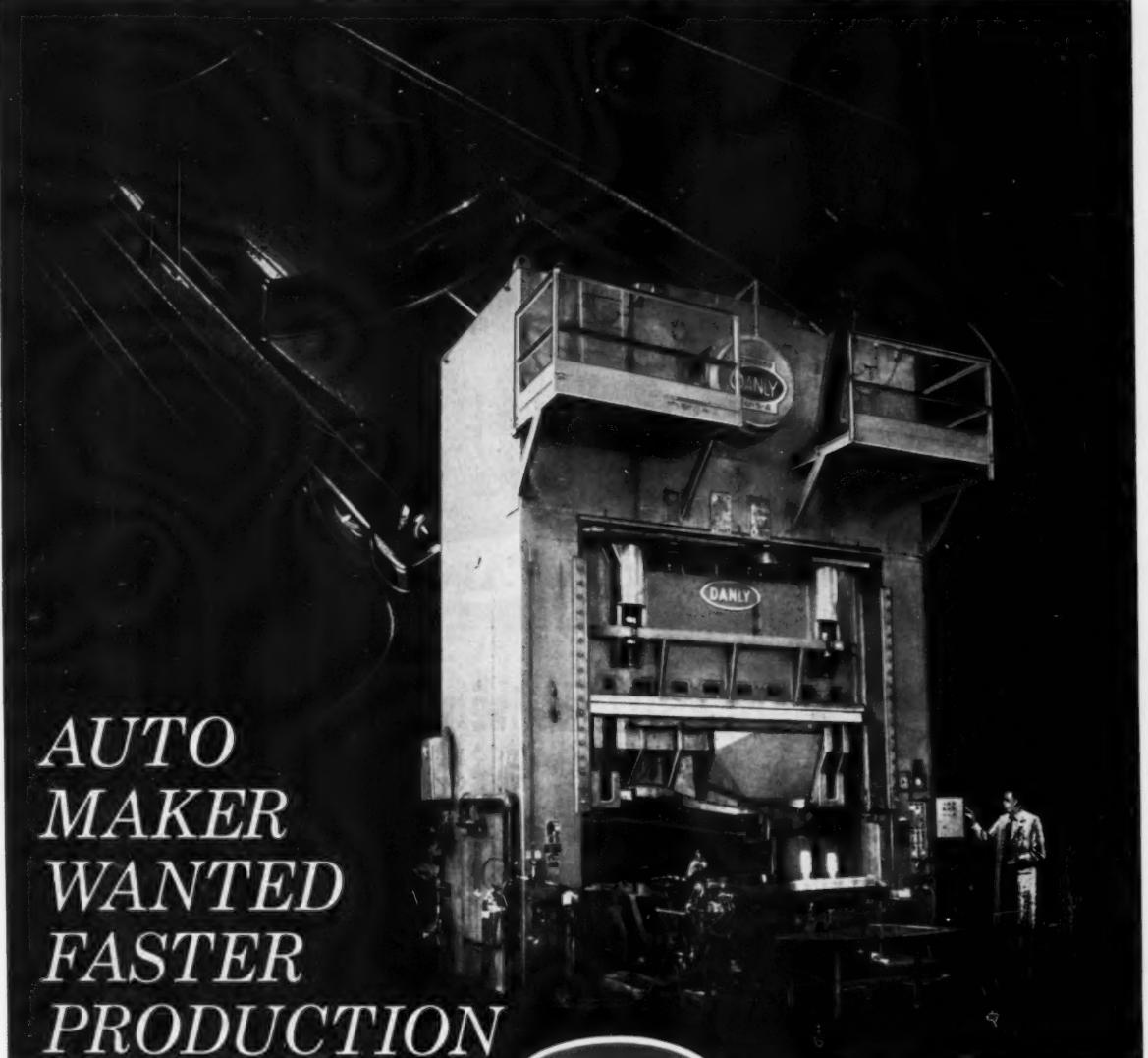
### Press-Brake Control

Push-button control on any press brake is provided by the Autobend attachment of the General Automation Corporation, Flushing, N. Y. Features include: push-button programming, automatic and whipless bending, stepless speed control, easier work handling, and two-operator control when desired. Installation requires no major changes of the press brake. With the device, the operator merely steps on an electric pedal and follows the work up—all in one easy operation.

**Circle 617 on Readers' Service Card**

### Redesigned Mini-Grinder

Bigger bearings and a larger rotor shaft are two of many construction improvements made by Buckeye Tools Corporation, Dayton, Ohio, in its 14G-800 series Mini-Grinder, a small air tool for precision grinding. Collets have been simplified in design, while the exhaust system has been refined by adding a built-in muffler. Despite



**AUTO  
MAKER  
WANTED  
FASTER  
PRODUCTION**

*...and got it from*

**DANLY**

Deep draw body parts were the bottleneck when presses for the job couldn't deliver more than 7 fender draws per minute. So Danly supplied a double-action press equipped with a DANLY 2-SPEED CLUTCH that automatically speeds up approach and return of the slides, but keeps draw speed safe and slow. The rate was raised to 10 draws per minute without speeding up the critical drawing action. Output jumped from 420 to 600 parts per hour . . . a healthy 43% improvement.

And, typical of Danly equipment, both press and clutch have performed without a single interruption in output for maintenance. Another example

of Danly ability to solve metal stamping problems with dependable, versatile equipment . . . this time with a low-inertia, 2-SPEED CLUTCH that makes a top-notch press even better!

Danly manufactures a complete line of mechanical presses, in capacities from 25 tons to 4,000 tons . . . and up. Send for your copy of the Condensed Catalog of Danly Presses and ask for detailed information on The DANLY 2-SPEED CLUTCH . . . now.



**DANLY**

DANLY MACHINE SPECIALTIES, INC., 2100 S. LARAMIE AVE., CHICAGO 50, ILLINOIS

MACHINERY, November, 1960

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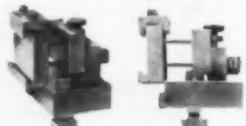
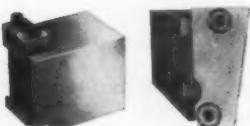
## Reed Thread Rolling Attachments For Over 100 Different Screw Machines and Automatic Lathes



STANDARD SERIES B

Reed thread rolling attachments were developed with the assistance and cooperation of screw machine and automatic lathe manufacturers. This close association has resulted in the development of a versatile tool offering wide capacity for varied applications to meet the demands of thread and form rolling requirements.

Adapters for over 300 different cross slide applications



Special attachments designed and built for single and multi-purpose applications

*Write for your copy of Thread Rolling Attachment Bulletin B-2 for helpful information on Thread and Form Rolling*



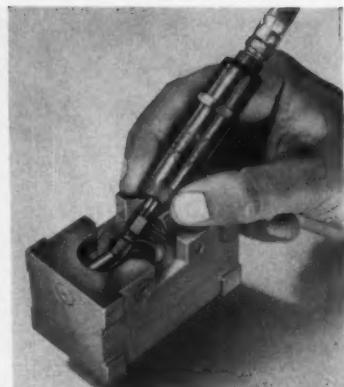
TRA-170

### REED ROLLED THREAD DIE CO.

*Specialists in Thread and Form Rolling Tools and Equipment*  
HOLDEN, MASSACHUSETTS, U.S.A.

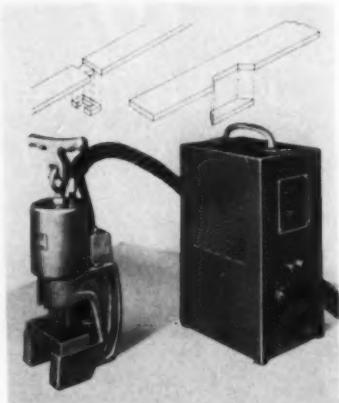
Sales Offices in: Buffalo, Chicago, Cleveland, Compton, Calif., Denver, Detroit, Englewood, N. J., Houston, Indianapolis, Milwaukee, Montreal, New York City, Phila., Pittsburgh, St. Louis, Syracuse, Toronto

242 For more data circle this page number on card at back of book



these changes, the grinder remains one of the smallest and lightest units on the market. Weighing only 5 ounces, it measures 13/16 inch in diameter by 3 7/8 inches long, with a 13/32-inch offset. Infinite speed control over the vane type air motor's 0- to 50,000-rpm range is provided by a ring throttle. Inlet and exhaust air flows through the bearings for lubrication and cooling.

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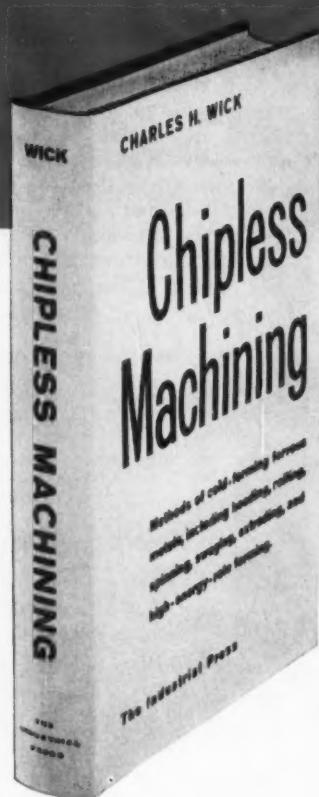


### Portable Notching Presses

A series of Hydramic notching presses is announced by W. A. Whitney Mfg. Co., Rockford, Ill. Three models with capacities of 10, 20, and 30 tons are available to handle maximum notching dimension from 2 by 1 inch to 2 1/2 by 2 inches in metal thicknesses up to 3/8 inch. A 1/2-hp hydraulic power unit is standard. Both the power unit and the press can be hand carried to the work. Press weights are: 10 ton, 30 pounds; 20 ton, 60 pounds; and 30 ton, 75 pounds. The power unit weighs 20 pounds.

Circle 619 on Readers' Service Card

MACHINERY, November, 1960



COLD-HEADING . . . THREAD-ROLLING . . . SPLINE ROLLING  
POWER SPINNING . . . ROTARY SWAGING . . . RADIAL FORGING  
COLD FORMING . . . COLD EXTRUSION . . . EXPLOSIVE FORMING

#### COVERS ALL THESE NEW PROCESSES

A new how-to volume on the subject of Chipless Machining—shaping metal parts without the production of chips. This technical book deals with the cold forming of steel by such processes as extrusion, radial forging, spline rolling, power spinning, and explosive forming.

This basic, practical guide is an important addition to your technical library because it brings together hitherto unavailable and widespread information about these newer processes in one convenient, useful text. It describes and illustrates in detail:

- the newer methods of cold forming
- pertinent data on economies resulting from savings in time and materials
- specific product design data and methods information of each process
- the range of various processes, their advantages and limitations—and their typical applications

The emphasis is on practice—theory is at a minimum. An extensive bibliography is provided for each process.

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**502 Pages**

**326 Illustrations**

#### OF VALUE TO:

**TOP MANAGEMENT**—Methods of producing improved products, faster and cheaper.

**DESIGN ENGINEERS**—Design and redesign factors for reducing costs, increasing output.

**PROCESS PLANNERS**—Comparative advantage of methods.

**TOOL ENGINEERS**—Essential rules, examples of tools.

**PRODUCTION MEN**—Details of operation and machines.

**PURCHASING EXECUTIVES**—Cost saving opportunities described and illustrated

This book can also be used as a reference source in any metal processing or production planning course.

**CONTENTS** Chipless Machining. What it is and What it is not—Metallurgical Consideration of Plastic Deformation—Cold-Heading—Thread-Rolling—Rolling of Serrations, Splines & Gears—Power Spinning—Rotary Swaging, Radial Forging and Cold Forming of Multiple-Diameter Shafts—Cold Extrusion of Steel—Selecting of Materials and Designing Parts for Cold Extrusion—Applications of Cold Extrusion—Production of Slugs and Secondary Operations—Phosphate Coating and Lubricating for Cold Extrusion—Die Design for Cold Extrusion of Steel—Press Selection for Cold Extrusion—Explosives and Other High-Energy-Rate Forming Methods.

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M11/60

## Snyder Special Transfer Machine for Defining Engine-Block Castings

A special transfer type machine designed to defin automotive V-8 engine-block iron castings at a rate of 240 castings per hour at 100 per cent efficiency has been built by the Snyder Corporation, Detroit, Mich. This is said to be the first transfer type machine with automation to be used in a foundry to remove fins by automatic means. Performing laborious work formerly done by manual labor with air hammers, it applies the same principles of transfer, in-process gaging, and part orientation as those used on transfer machines for removing metal with cutting tools. Instead of cutting tools, the machine utilizes air-cylinder-actuated, round hardened steel punches, and hardened steel form-chipping tools actuated by air hammers, to remove the fins from the entire casting.

The machine, Fig. 1, receives the castings from another automatic machine where the top, bottom, ends and cylinder-head faces were rough-ground. From the Snyder defining machine, the castings go through a shot-blasting machine and an impact turnover to complete the conditioning of the casting before machining.

Basically, the definning machine is a thirteen-station transfer type made up of a series of definning

segments as shown diagrammatically in Fig. 2.

In the first section definning operations are carried out on each end. Then the parts, which are moved from station to station by a rotating finger transfer mechanism, feed into the second section,

which is at right angles to the first section. Here the blocks move endwise where top and sides are definined. Next the blocks move crosswise into a turnover automation unit where they are turned over 180 degrees and fed endwise through the last section where bottom and side areas are definined.

At the end of the line is a marking machine that performs a type

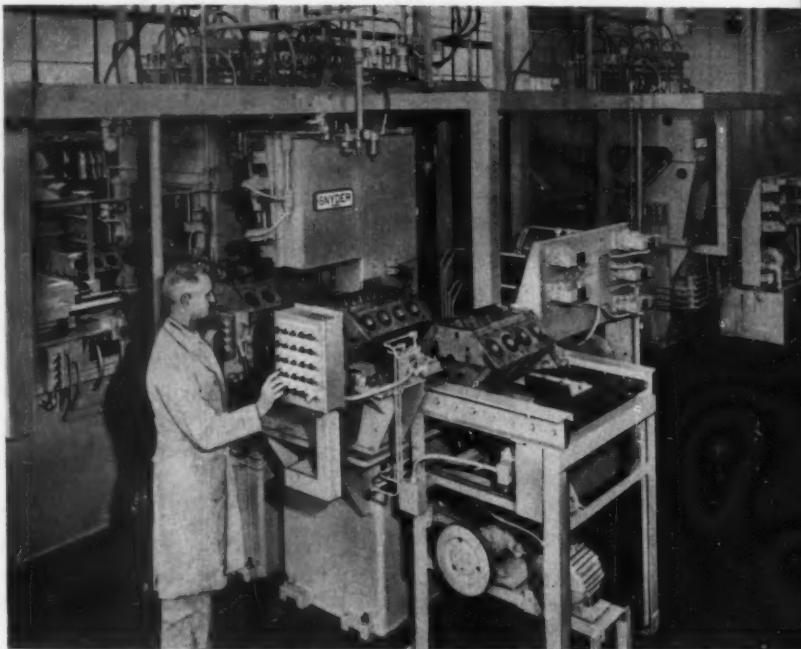


Fig. 1. Thirteen-station Snyder special machine designed to defin iron engine-block castings at the rate of 240 per hour

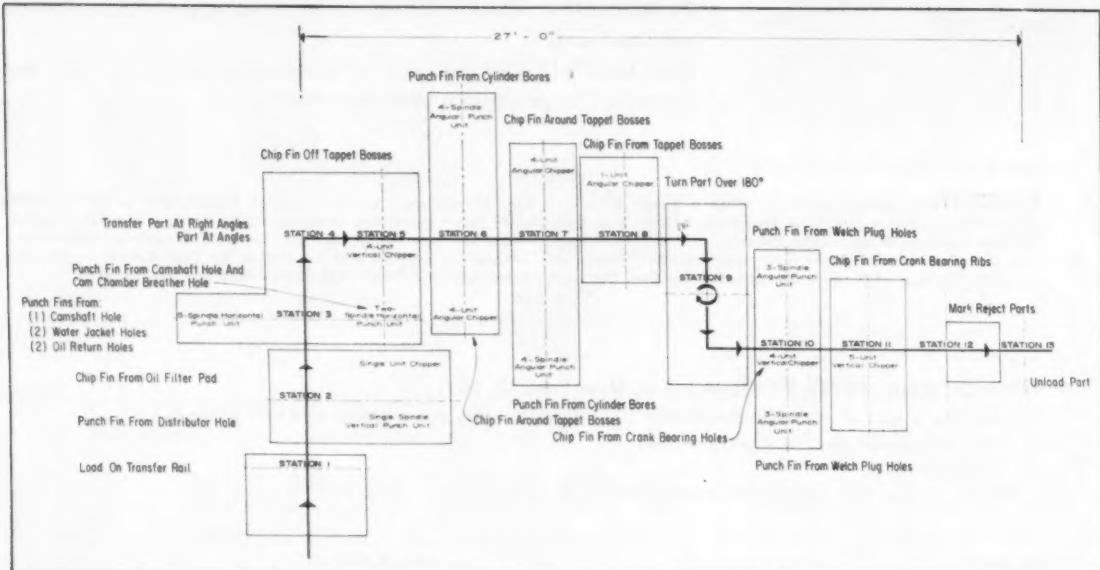
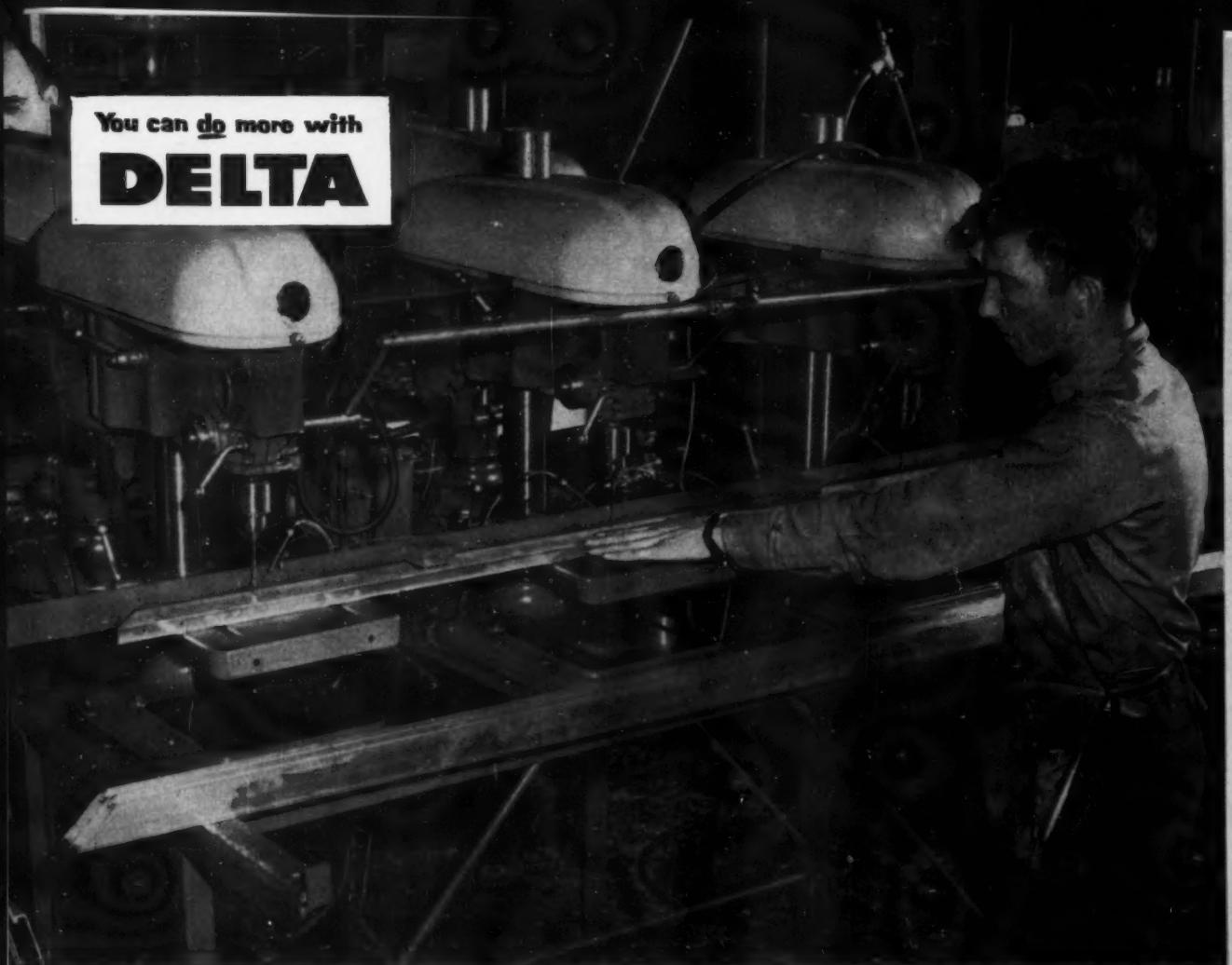


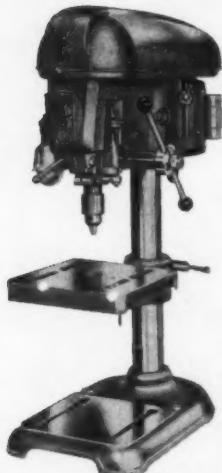
Fig. 2. Floor plan showing operation sequences and direction of casting flow through machine shown in Fig. 1

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## Cuts drilling time by 60%



Delta 15" Drill Press, also  
20", 17", 14" and 14" Super-  
Hi Sensitive. Available in  
floor, bench, and multiple  
spindle models.

This substantial reduction in drilling time is the result of ingenuity plus a combination of Delta drill presses in two and three spindle set-ups. Spacing machines at a specified distance between holes and using bar connecting operating levers, Capitol Products Company provides simultaneous drilling in production of aluminum storm doors. The Mechanicsburg, Pa. firm has standardized on Delta drill presses because these tools assure the adaptability, ruggedness, and accuracy required. In addition, maintenance and servicing are greatly simplified.

Delta drill presses have set the industry standards for years—they cost less to buy, less to operate and less to maintain. Visit your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages)—choose the tool to fit your needs from the world's most complete line. For FREE Delta Industrial Catalog showing 61 machines, 302 models, over 1400 accessories, write: Rockwell Manufacturing Company, Delta Power Tool Division, 614LN Lexington Ave., Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

DELTA INDUSTRIAL TOOLS

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**ROCKWELL**



of in-process gaging function. If any of the definining units does not travel its full distance during the processing sequence, this is an indication of incomplete fin removal and produces a reject part. To identify these reject parts, the machine control system includes a memory circuit tied in with the marking unit at Station 12. Thus, incomplete travel of any definining unit on the machine causes the reject part to be marked before it leaves the definining line.

Air power is utilized throughout the machine. Hydraulic power is used only to index the parts and operate the locators. This is provided by two separate hydraulic pump and tank units along the machine line. The parts are slid

from station to station on fixed hardened rails. In the first section the parts are positioned for defining by rough locators that engage main bearing holes in each end. In the second section, location is made by a locator in one of the Welch plug holes. Location in the third section is made on qualified surfaces between tappet bosses.

To keep cycle time to a minimum, the second and third sections define while the first machine is transferring. The transfer into the second and the turnover between the second and third sections operate while the first section is defining.

The punching stations utilize hardened rough steel punches with special face shapes. These

punches and their slides are moved into the part as a weighted unit by an air cylinder to provide the necessary impact force to remove the fin. Chipping stations utilize special hardened steel form tools with shanks that fit into standard air-hammer units. Heads with assemblies of chipping units move into contact with the casting and the hammers operate for a set time period. If the fin has not been removed within this preset time cycle, incomplete head travel occurs and the memory reject-part stamp sequence is initiated. An automatic conveyor system is built into the machine to carry all chips and fins out of the machine and into a tote box.

Circle 620 on Readers' Service Card

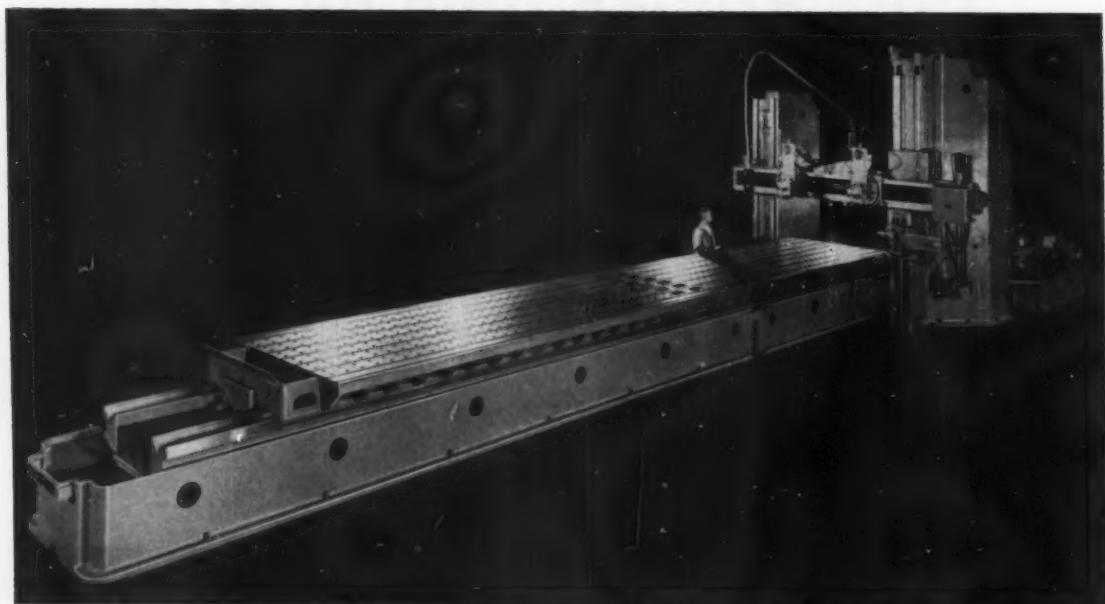
### Rockford Extra-Long Hy-Draulic Open-side Planer

A heavy-duty Hy-Draulic open-side planer, believed to be the world's longest machine of this type, has been built by the Rockford Machine Tool Co., Rockford, Ill. The table working surface of this 72- by 72-inch planer is 34 feet in length. Designed to obtain the ultimate in efficiency and economy, this huge machine is extremely easy to operate directly from the pendant. The big table may be started, stopped, inched, or

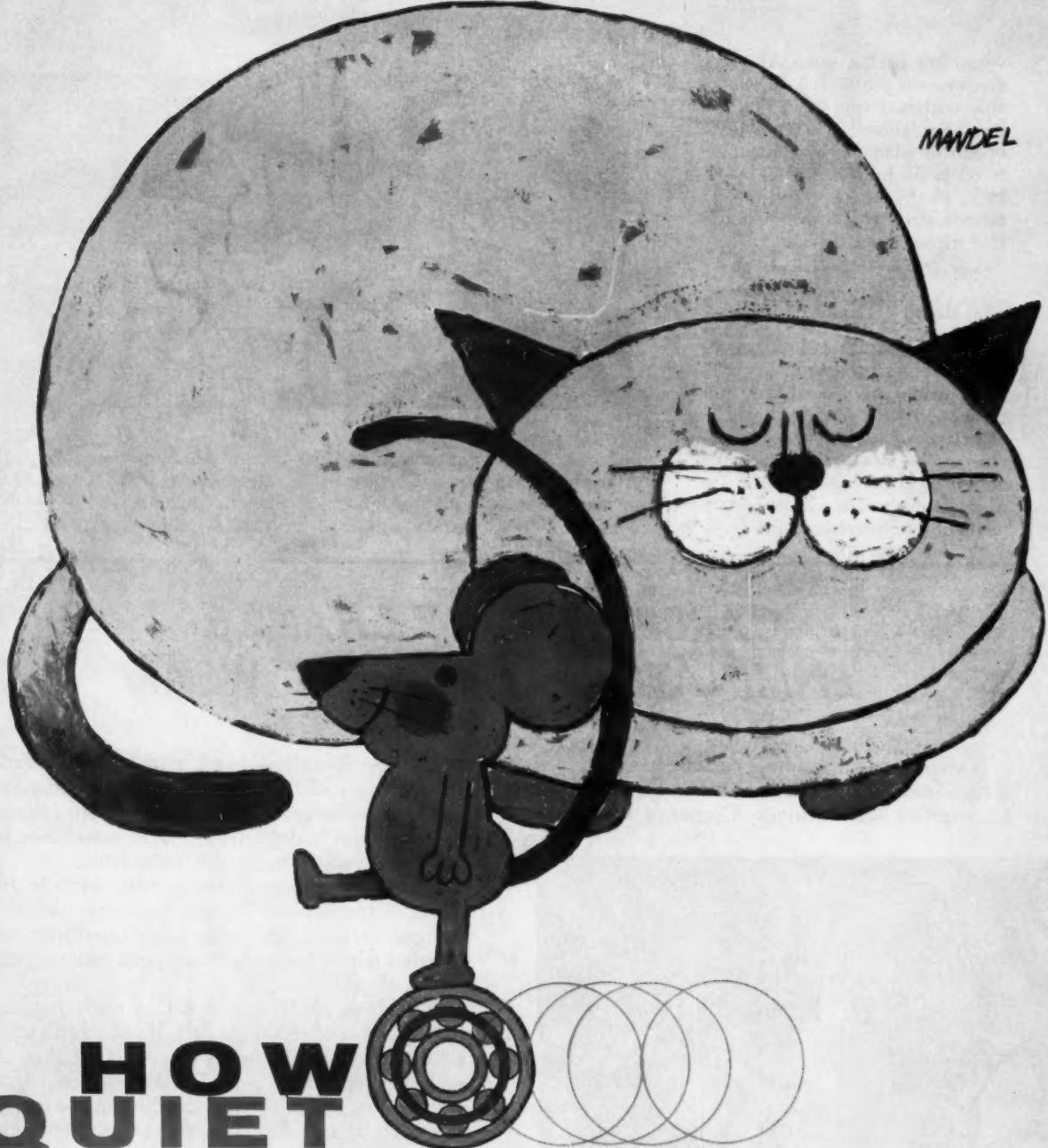
jogged in either direction. Any speed range can be instantly selected and the exact cutting speed obtained at the control pendant. Complete positioning of the toolheads, selecting feed or traverse and the amount of feed desired, and the main motor and rail elevation are all pendant controlled.

Built for greater precision and more extensive use of carbide tools than preceding machines, this new model has many exclusive Hy-

Draulic design and safety features, such as one-piece L-shaped rail, which assures continued accuracy over the full life of the machine; heavy box-section table, which is carried on wide-angle V-ways of optimum center distance, and which cannot get off its ways and cause damage, because it is solidly anchored to the piston rod; and rugged sidehead and railhead construction, which permits maximum utilization of the proper tool for each specific job. The advantages of a double-housing planer and the



Hy-Draulic open-side planer with extra-long table and removable outboard support brought out by Rockford Machine Tool Co.



MAYDEL

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Federal Ball Bearings are to be seen, but not heard! Elusive noises are intercepted by inspection engineers at "quiet control" points all along our production line. They want to hear the soft, sweet purr that signifies a perfect bearing, because that's the only kind we'll tolerate. That's why every bearing goes through

scores of quality control tests before we send it out. Customers who get these perfect bearings number among the most respected names in American industry. We'd like to include you. Start with our catalog—over 12,000 ball bearing sizes, hundreds of types. Send for it today. THE FEDERAL BEARINGS CO., INC., Poughkeepsie, N.Y.

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manufacturers*

versatility of the open-side type machine are provided by a removable outboard support which has its own sidehead. This Hy-Draulic open-side planer is also manufactured in 36- by 36-inch, 42- by 42-inch, 48- by 48-inch, and 60- by 60-inch sizes with conventional or H-3 triple-circuit drives.

Circle 621 on Readers' Service Card

### Rotary Thread Mill

A Vetcoa rotary thread-milling attachment designed with an integral lead-screw is being introduced by the Vernon Tool Co. of Arizona, Phoenix, Ariz. The device can be mounted on the table of any vertical milling machine or jig borer, and is available as a manually or electronically oper-



ated unit. For internal threading, an involute form cutter is held in the machine spindle, and the table of the mill feeds vertically as it

rotates. For boring operations, the mill can be quickly converted for use as a conventional rotary table.

Circle 622 on Readers' Service Card

## CARBIDE GRADE CHANGE ELIMINATES SEVERE EDGE WEAR

A change in the grade of carbide has produced a significant increase in tool life at the Universal Corrugated Box Machinery Corporation, Linden,

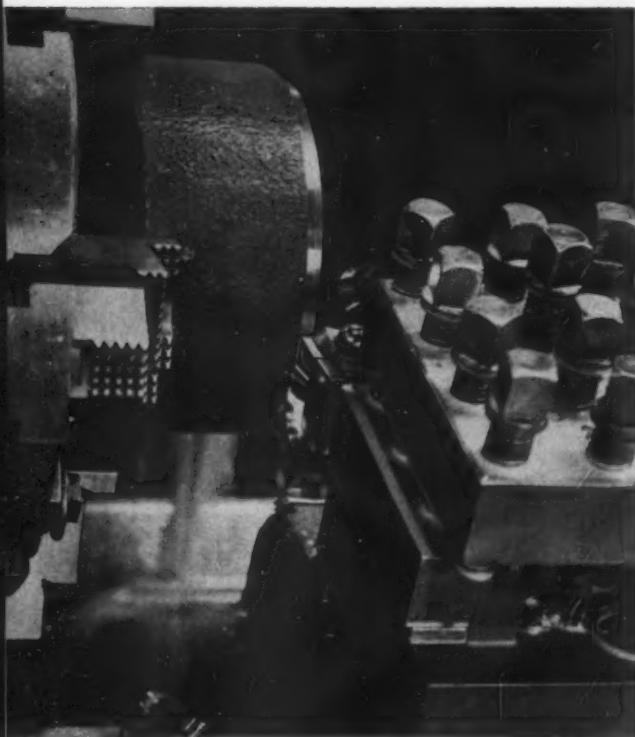
N. J. The operation, not a particularly difficult one, consists of turning 1045 hot-rolled carbon-steel blanks for gears used in the concern's line of rotary slotters and printers. It is done on a No. 1A Warner & Swasey hydraulic turret lathe.

The job had been running with carbide triangular throw-away inserts meeting industry designation C-50. This is the grade usually recommended where both edge wear and cratering are potential problems.

A methods study indicated that while running through a lot of sixteen blanks, three inserts were consumed. The edge wear was so great that all six cutting edges of each insert were used in a normal run. Depth of cut varied from  $1/4$  to  $1/2$  inch, at 196 and 236 rpm. Feed was 0.008 and 0.012 inch, with a speed of 305 sfm.

For each lot, the time spent indexing and replacing the inserts averaged ninety minutes. In addition, the rapid rate of wear on each cutting edge forced the operator to check size frequently and to readjust the cross-feed dial continually.

The condition was improved when a different carbide grade (Adamas 434) was substituted. This grade is designed specifically for machining steel with heavy feeds. It combines good resistance to shock, wear, and cratering. It is now possible to completely rough- and finish-turn all sixteen gear blanks with one cutting edge of one insert. Even then, edge wear is not severe enough to require any cross-feed dial adjustment.





# TOOLROOM GRINDERS

MANY UNUSUAL FEATURES  
ASSURE HIGH EFFICIENCY

## MODEL 310 CUTTER AND TOOL GRINDER

This grinder efficiently performs a wide range of grinding operations. Thus, tools and cutters can be ground in shortest possible time to keep production costs at a minimum.

### FEATURES:

- Universal operating positions—all within comfortable reach of operator
- Anti-friction cross saddle mounting assures sensitive control to cross feed
- Table traverses on precision roller chains, giving "fingertip" control
- Table dogs reversible—one end spring loaded and the other a dead stop
- Table swivels a full 90 degrees in left-hand direction and 45 degrees right-hand
- Large diameter wheel spindle, mounted on specially selected preloaded bearings
- Universal Cutter Head adjustable to swing from 8" to 12" diameters
- Cutter Head and Tailstock provided with clearance angle setting adjustments.

For additional information, write for *Micromatic Bulletin 139W*.

## MODEL 1014 UNIVERSAL TOOLROOM GRINDER

This 1014 Universal Tool Room Grinder is designed to give extraordinary sensitive control that results in high quality external and internal grinding.

Wheelhead has deep throat capacity and wheel position is centralized in relation to table. This permits surface grinding and offers special facilities for broach grinding.

The extra Universal Cutterhead extends the versatility of this highly accurate machine to cover tool and cutter grinding.

### FEATURES:

- Hand cross feed and vertical feed in .0001" increments
- Auto cross feed per reversal of table of .0001" to .007" over .025" (reduction in work diameter of .050")
- Automatic table traverse, 4 speeds provided. Micrometer adjustment to table traverse in .001" divisions
- Wheelhead saddle on anti-friction mountings
- Precision built wheelhead motor on anti-vibration mountings
- Wheel spindle unit swivels full 360°
- Five external grinding wheel speeds
- Grinding wheels fitted on either end of wheel spindle. Nitrallylo spindle runs in plain bearings
- Vernier scales to wheelhead and table swivels
- Fast cross traverse to wheelhead for setting purposes.

For additional information, send for *Micromatic Bulletin 206Q*.

**MICROMATIC HONE CORP.**

8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN



# News OF THE INDUSTRY

## California

R. M. HATCHER has been appointed manager of applied manufacturing research and process de-



R. M. Hatcher, manager-applied mfg. research and process development, Convair Division, General Dynamics Corporation

velopment at the CONVAIR (San Diego, Calif.) DIVISION OF GENERAL DYNAMICS CORPORATION. In his new position he will have jurisdiction over factory estimating, operating controls and standards, manufacturing planning and methods, manufacturing development, and technical services.

DONALD D. MALLORY has been named manager of product operations for the components division of HUGHES AIRCRAFT Co., Culver City, Calif. Mr. Mallory will be responsible for the production of parametric amplifiers and microwave components developed by the division's electrophysics laboratory.

CALVIN C. WEIGOLD has been appointed plant manager of the REED INSTRUMENT BEARING Co., Los Angeles, Calif., a division of SKF INDUSTRIES, INC., Philadelphia, Pa. Mr. Wiegold joined SKF in 1958 as a senior staff industrial engineer.

## Illinois and Minnesota

CLEARING, DIVISION OF U. S. INDUSTRIES, INC., Chicago, Ill., has announced the appointment of HENRY M. CROSSEN as vice-president of manufacturing. Mr. Crossen came to Clearing as director of administration in October, 1959, later becoming director of manufacturing. T. SINGELIS has been named vice-president of marketing services for the



Henry M. Crossen, vice-president-manufacturing, Clearing, Division of U. S. Industries, Inc.



T. Singelis, vice-president of marketing services, Clearing, Division of U. S. Industries, Inc.



Einar K. Johansen, vice-president-engineering, Clearing, Division of U. S. Industries, Inc.

division. In his new assignment, Mr. Singelis will be responsible for Clearing's market research, sales analysis, order and customer service, and advertising and sales promotion. Also announced was the appointment of EINAR K. JOHANSEN as vice-president-engineering. Mr. Johansen was one of the founders of the Clearing division and is well known in the metal-forming field.

The general offices of JOSEPH T. RYERSON & SON, INC., warehousing subsidiary of INLAND STEEL Co., have been moved into the firm's new general office building recently completed at 2621 W. 15th Place, Chicago, Ill. The location is adjacent to Ryerson's Chicago plant.

HOWARD B. CARROLL, JR., has been elected president and general manager of the SHELDON MACHINE Co., INC., Chicago, Ill. Since 1956 he has held the position of vice-president.

VICTOR C. NIELSEN, sales engineer for NORMA-HOFFMANN BEARINGS CORPORATION, Stamford, Conn., has been assigned to the firm's Minneapolis, Minn., office. Mr. Nielsen will cover the territory of Minnesota, Iowa, and the Dakotas.

## Want to cut costs on parts like these?



### Here's how tracing will help you save

The simple, basic setup shown above handles nearly 300 different parts for a well-known manufacturer of drive line components. All work is performed on one Gisholt MASTERLINE No. 4 Ram Type Turret Lathe with a JETracer on the rear of the cross slide. Standard tools on the hex and square turrets are used to face, chamfer and reduce the stock while the JETracer finishes all diameters, steps, blends and radii. The 6 1/8"-long, 2"-diameter stepped shaft (above at left) is typical and is completed in two operations with total f.t.f. time only 4.95 minutes.

#### Here are just a few things the JETracer can do for you:

- Shorten setup and change-over time
- Simplify machining and eliminate operator errors
- Save cost of form tools, multiple tool blocks and holders
- Reduce inspection time (only one length and one diameter need checking)

Minimize or eliminate secondary operations (through finer finish, greater accuracy)

Increase production through automatic machining of complex surfaces

Free operator to handle extra units or perform other work

Gisholt has developed a complete line of JETracer units for use with ram and saddle type turret lathes, automatic turret lathes and single-spindle chucking lathes. These include rear cross slide, turret and independent slide mounted units, single or multi-pass types. All are designed to operate at full capacity of the machines to which they are applied, without limiting machine functions or restricting the use of standard tools.

You'll want to see for yourself how the JETracer adds flexibility, speeds operations and cuts costs on standard and problem parts. Send the coupon today for your free copy of the new JETracer catalog, or call your Gisholt Representative for complete information.

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MACHINING COMPANY  
Madison 10, Wisconsin

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## Michigan

METALLURGICAL PRODUCTS DEPARTMENT, GENERAL ELECTRIC Co., Detroit, Mich., announces that D. B. BOSWELL has joined the carbide application engineering subsection of the marketing section as an application engineer. Mr. Boswell will work on component and percussive applications with field sales and manufacturing. WALTER EBLING, who has been in market development and research of the Metallurgical Products Department, has joined specialty alloys marketing as a sales representative.

THELMA L. WATSON was appointed executive vice-president and treasurer of CARTER PRODUCTS Co., INC., Grand Rapids, Mich. Miss Watson has been with the Carter Co.



Thelma L. Watson, executive vice-president and treasurer of Carter Products Co., Inc.

for nineteen years. For the past ten years she has been treasurer of the firm, and has also served as sales manager for the Guide Line Light Division, as well as director of advertising for all product divisions.

THOMAS J. AULT has been appointed president of the Automotive Division, Detroit, Mich., of the BUDD Co., Philadelphia, Pa. Mr. Ault joins the Budd Co. after twenty-three years with BORG-WARNER CORPORATION, where he served in various executive capacities.

COGSBILL TOOL PRODUCTS, INC., Oak Park, Mich., has announced the election of GENE A. WHITE as president, succeeding FRANK A. COGSBILL, who has been named vice-

chairman of the board of directors. BRADLEY N. BROWN has been elected treasurer.

NORMA-HOFFMANN BEARINGS CORPORATION, Stamford, Conn., has named PAUL NOWAK and JOHN R. CIUPAK sales engineers. The two men join the firm's Detroit office staff, covering the Michigan territory.

STAR CUTTER Co., Farmington, Mich., has purchased the Baker line of keyseaters, profile grinders, and keyseater cutters from BAKER BROTHERS, INC., Toledo, Ohio.

## New York and Connecticut

GLEASON WORKS, Rochester, N. Y., announces six promotions in their sales and manufacturing divisions. DAVID D. SOMERS has been appointed assistant export manager. ALFRED J. MURRER has been named assistant factory manager. WALTER E. ANDRUS becomes assistant production manager. DONALD L. WHITMORE, product development engineer, has been assigned the additional responsibilities of liaison engineer for Gleason Works Ltd. in England. JOHN H. FOSTER assumes the position of superintendent of the cutter division. HAERLE D. WESTGATE was advanced to superintendent of the foundry.

ROGER W. TUTHILL has been appointed manager of engineering for AIR REDUCTION SALES Co.'s special products department, New York City. In his new capacity, Mr. Tuthill will supervise the design and construction of all of Airco's custom-made equipment involving uses for gases and the cutting and joining of metals.

GLEASON WORKS, Rochester, N. Y., has announced four promotions in its engineering department. OLIVER F. BAUER has been named chief designer of the auxiliary machine group; EARL D. DAMMERT becomes chief designer of the universal machine group; PHILIP H. GOELTZ has been named chief standards engineer; and HERMAN A. MALE assumes the post of chief designer, production machine group.

WALLACE E. ANDERSON has been made vice-president and general sales manager by Cosa CORPORATION, New York City, for all its imported precision and automatic machine tools. Mr. Anderson was previously associated with BROWN & SHARPE MFG. Co. as general sales



Wallace E. Anderson, vice-president and general manager-imported precision and automatic machine tools, Cosa Corporation

manager for all of that company's products; and during the last three years, as vice-president and general manager of the company's Industrial Products Division.

LEONARD L. DECOSTER, manager of operations research and synthesis of GENERAL ELECTRIC Co. since 1955, has joined the newly formed division planning operation of the company's Industrial Electronics Division. He will be headquartered at 161 E. 42 St., New York City.

CURTIS H. LOCKE has been appointed sales manager, Machine Tool Division of BUFFALO FORGE Co., Buffalo, N. Y. Mr. Locke replaces JAMES MOSELL, who is retiring after forty-eight years with the company.

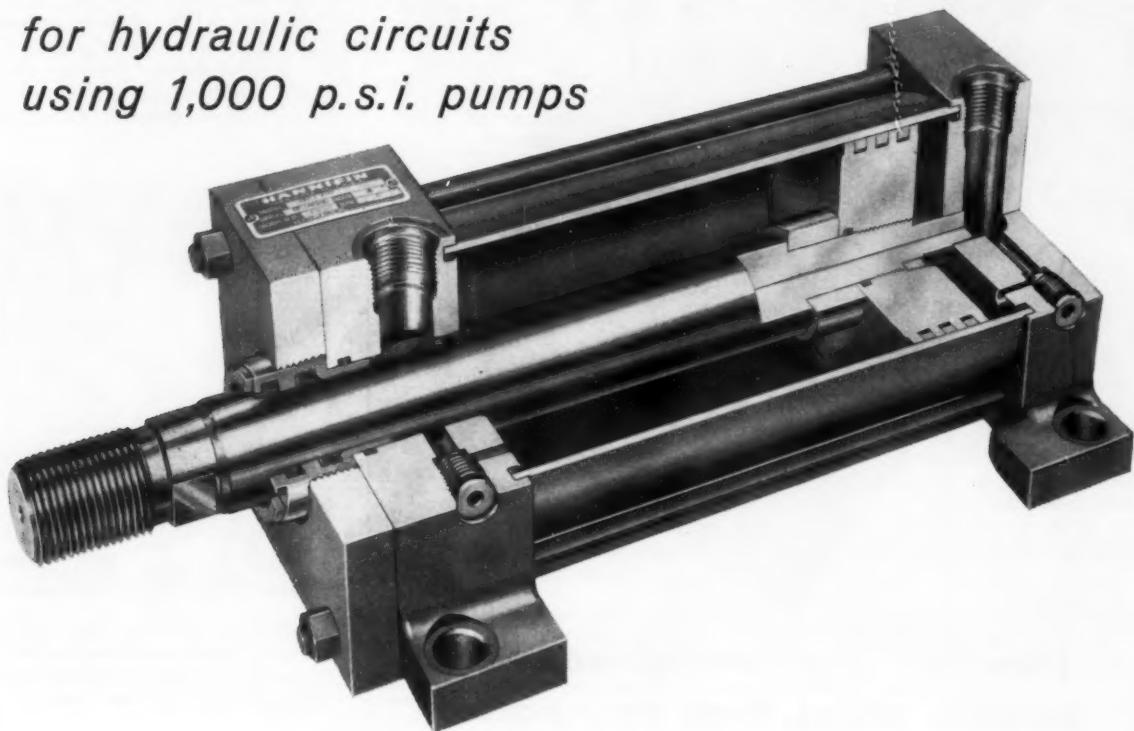
PRODUCTO MACHINE Co., Bridgeport, Conn., announces the formation of a new division for the design, development, and manufacture of plastics machinery. Called the Plastics Machinery Division, it will have its engineering, manufacturing, and administrative facilities situated at the main Producto plant, Bridgeport.

## Ohio

ROTOR TOOL Co., Cleveland, Ohio, has named RICHARD ALLCHIN president, succeeding H. P. BAILEY, company founder and former president of the firm. Mr. Bailey has become board chairman of the Rotor Tool Co. He is also a director of the parent company, the COOPER-BESSEMER CORPORATION. A number

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of new executive appointments has been announced. L. W. Dwors is vice-president, manufacturing; HUGH L. WHITEHOUSE became director of engineering and secretary-treasurer; JAMES MURPHY is a company officer in addition to his present duties as controller; and PAUL VAN SITTERT is now director of research.

WILLIAM G. BANCROFT has been appointed manager of the grinding wheel plant for the Products Division of the CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio. He



William G. Bancroft, newly appointed manager of the grinding wheel plant, Products Division of Cincinnati Milling Machine Co.

succeeds MAURICE GORMLY, who is now manager of the division. Mr. Bancroft has been with Cincinnati Milling since 1953. Prior to his new position, he was manager of manufacturing engineering.

JAMES A. BRAY has been appointed to the new position of manager of trade relations for the E.W. BLISS CO., Canton, Ohio. For many years Mr. Bray has been associated with the MACKINTOSH-HEMPHILL DIVISION of the company in Pittsburgh, Pa., most recently as assistant general sales manager.

### Pennsylvania, Maryland, and District of Columbia

E. W. BLISS CO., Canton, Ohio, has named CHARLES E. PETERSON division manager in charge of the MACKINTOSH-HEMPHILL DIVISION, Pittsburgh, Pa. He succeeds J. R. PATTERSON as chief executive of the division. Mr. Patterson, formerly vice-president in charge of MACKINTOSH-HEMPHILL, was recently elec-



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a book that explains and relates all the complex aspects of product development.

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National President, MTM Association for Standards and Research

This is the first book that gives manufacturers a complete picture of successful product development. Intended for management with little or no experience with this subject, THE NEW PRODUCT is a guide they can turn to for help in every area of product development, from where to get ideas to how to advertise. It is basic, yet it coordinates and unifies the many tangibles and intangibles that complicate and mystify even manufacturers experienced in developing new products. In the author's own words, "It is a serious attempt to give practical help to both the old hand at the game and also the neophyte."

It describes in detail how to find ideas, how to test, develop and sell new products. It provides useful checklists that aid a manager in avoiding common pitfalls and at the same time help him secure the step-by-step success of his project.

The entire subject is approached from the viewpoint of general management. Basic concepts of top management planning and organization for new product development are covered, as well as each major functional area of the business enterprise (see contents, left) regarding the successful development and marketing of new products.

This is an important book for today's buyers' market, where success depends on how well a company competes. Today the manufacturer is in the challenging position of having to recognize and utilize his resources to the fullest—to seek new products for new business. Mr. Karger's book provides an answer for the farsighted manufacturer who wants to know how he too can develop new, successful products; new, profitable markets. Order your copy today! Money refunded if you are not completely satisfied.

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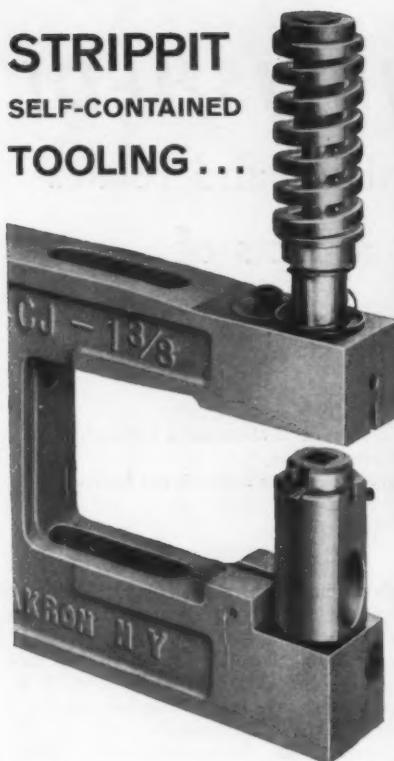
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1. **no expensive custom dies**—save all the time and cost involved in designing and building custom, single-purpose dies.
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9. **nationwide sales and service**—by trained tooling methods engineers in all major industrial areas. Manufacturing plants in Akron, N.Y., Los Angeles, Calif.; warehouse in Chicago, Ill.
10. **specify "Strippit"**—the original system of self-contained tooling. There are imitations but no substitute for Strippit engineering know-how, tested and proved designs and materials, first-class workmanship and the other advantages of doing business with a reputable organization that has been in business for 35 years.

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ted president and chief executive officer of E. W. Bliss.

MACHINERY ASSOCIATES, INC., 325 E. Lancaster Ave., Wynnewood, Pa., are now exclusive representatives in Philadelphia and the surrounding area for KINGSBURY MACHINE TOOL CORPORATION, Keene, N. H. They will serve eastern Pennsylvania, southern New Jersey, Delaware, Maryland (except Garrett and Allegany counties), District of Columbia, and Virginia (Fairfax and Arlington counties only).

C. J. LANGLEY has been appointed assistant district manager for AIR REDUCTION SALES CO., a division of Air Reduction Co., Inc., New York City. Mr. Langley will assist N. F. Moody, district manager, in the sale and distribution of all Airco products marketed through the Philadelphia, Pa., district.

D. F. BOVIE has been appointed assistant manager, engineering services, in the Pittsburgh, Pa., district by AIR REDUCTION SALES CO., a division of AIR REDUCTION CO., INC., New York City. He will be responsible for the demonstration, installation, and maintenance of the company's products in that area.

WILLIAM A. KLAWITTER has been made supervisor of magnetic and expansion alloys research by the CARPENTER STEEL CO., Reading, Pa. In his new position, Mr. Klawitter is in charge of a group developing improved alloys for magnetic, glass sealing, and thermal expansion applications.

HOWARD O. BEAVER has been appointed assistant general superintendent of the CARPENTER STEEL CO. plant in Reading, Pa. Manager of mill metallurgy at the plant for the past two years, he was named plant metallurgist in 1951 and production metallurgist in 1957.

LEON MOLICK has been appointed manager of engineering for the Industrial Equipment Division, BALDWIN-LIMA-HAMILTON CORPORATION, Philadelphia, Pa. Mr. Mollick has been with the division as chief stress analyst for ten years.

Appointment of MUNTZ TOOL CO., Wayne, Pa., as exclusive agent to service all eastern railroads has been announced by WESSON CO., Ferndale, Mich. The Muntz territory will extend from the Eastern Seaboard to the western boundary of Pennsylvania.

MACHINERY, November, 1960

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## A simple plan to save money by steel standardization

### How many types of steel do you normally use?

Chances are you should examine your needs for alloy steel to see how many can be satisfied with just two types, 4340 through-hardening and 4620 carburizing.

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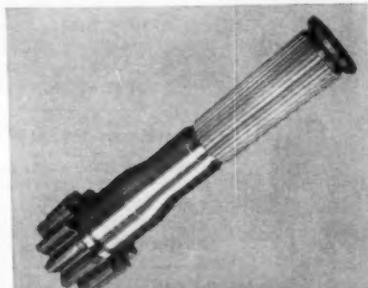
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Holding the Shippingport nuclear reactor's top head to its shell section is a job performed by 42 studs of AISI 4340. This through-hardening nickel steel provides essential strength and toughness.



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Swing shaft for giant power shovel made from 4340 nickel alloy steel for strength and toughness to take shock-loading in stride. This 9"-diameter, 36"-long shaft of 4340 nickel alloy steel transmits tremendous torque to a giant ring gear.



Sustained accuracy is assured in this heavy-duty milling machine by spindle and gear components of AISI 4340 and 4620 nickel alloy steels. They provide needed strength and wear resistance.

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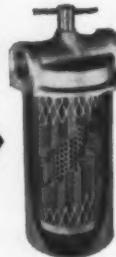
### Synclinal SUMP TYPE

CAPACITIES: 5-8-10-20-30-50-75 and 100 G.P.M.

PIPE SIZES:  $\frac{3}{8}$ "-1"- $1\frac{1}{2}$ "- $1\frac{1}{4}$ "-2"- $2\frac{1}{2}$ " and 3".

CONNECTIONS: Coupling—Male Nipple.

BY-PASS VALVE: Not Available.



### Synclinal LINE TYPE

CAPACITIES: 5-8-10-20-30-50-75 and 100 G.P.M.

PIPE SIZES:  $\frac{3}{8}$ "-1"- $1\frac{1}{2}$ "- $1\frac{1}{4}$ "-2"- $2\frac{1}{2}$ " and 3".

BY-PASS VALVE: Not available.

OPERATING PRESSURES: Up to 80 p.s.i.



### Bonded SUMP TYPE

CAPACITIES: 10-20-30-50 and 75 G.P.M.

PIPE SIZES: 1"- $1\frac{1}{2}$ "- $1\frac{1}{4}$ "-2"-and 2 $\frac{1}{2}$ ".

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BY-PASS VALVE: Available with or without



### Bonded LINE TYPE

CAPACITIES: 10-20-30-50 and 75 G.P.M.

PIPE SIZES: 1"- $1\frac{1}{2}$ "- $1\frac{1}{4}$ "-2"-and 2 $\frac{1}{2}$ ".

BY-PASS VALVE: Available with or without.

OPERATING PRESSURE: Up to 250 p.s.i.

OPERATING TEMPERATURES up to 300° F.



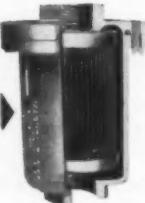
### Tandem SUMP TYPE

CAPACITIES: 10-15-20-40-60-100-150 and 200 G.P.M.

PIPE SIZES:  $\frac{3}{8}$ "-1"- $1\frac{1}{2}$ "- $1\frac{1}{4}$ "-2"- $2\frac{1}{2}$ " and 3".

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CHARLES P. HARBAUGH has been named product line manager-machine-tool sales, for the electronics division of ACF INDUSTRIES, INC., Riverdale, Md. Mr. Harbaugh joined the division from the Cosa Corporation in New York, where he was field sales manager for the company's imported machine tools.

GEORGE E. MERRYWEATHER, president of MERRYWEATHER-STRASMAN MACHINERY CORPORATION, San Mateo, Calif., has been elected president of the AMERICAN MACHINE TOOL DISTRIBUTORS' ASSOCIATION,



George E. Merryweather, president of American Machine Tool Distributors' Association

Washington, D. C. The election was announced at the Association's Thirty-Sixth Annual Meeting in Chicago, Ill., September 4. During the past year, Mr. Merryweather served as vice-president of the Association.

### Texas and Arkansas

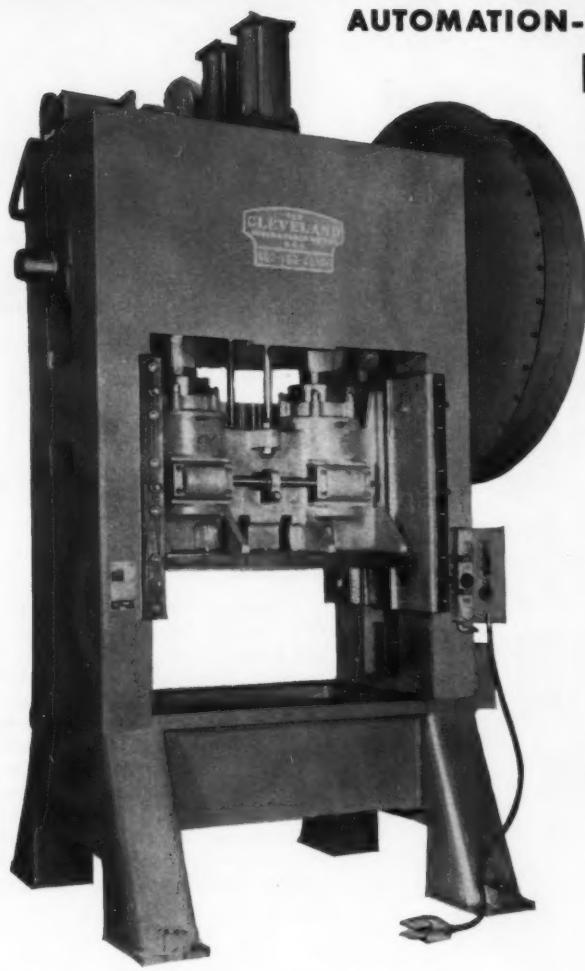
WAGNER ELECTRIC CORPORATION, St. Louis, Mo., announces that production of standard fractional-horsepower motors has started at its new manufacturing plant at Brinkley, Ark. The modern one-story, 90,000-square-foot building was designed for a continuous-flow layout of machines, assembly lines, and testing equipment.

The appointment of ROBERT L. (BOB) WALKER as manager, CLECO DIVISION, has been announced by the REED ROLLER BIT CO., Houston, Tex. In his new post Mr. Walker will work directly under JACK GRUNDY, vice-president—operations for Reed, coordinating activities of

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*Let's talk MONEY*—the money you save when you have a modern, cost-cutting Cleveland Press on your production line.

First there is *Production Money*—the money you make more of due to Cleveland's versatile, dependable performance.

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When you buy a CLEVELAND PRESS, the *cost-cutting money* you save plus the *profit money* it earns for you far surpasses the cost of replacing that old press with a modern, quality-built Cleveland Press. That's why it will pay you to look into the advantages Cleveland Presses offer.

Continuous, uninterrupted production is the "profit plus" this new Cleveland Double Crank Press is achieving at the Walker Manufacturing Company in Jackson, Michigan. This multi-station, automated Cleveland Press on each stroke pierces, extrudes and forms muffler heads at the rate of 45 strokes per minute (adjustable to 55 s.p.m.). This 150-ton press has a 48" x 36" bed and slide area, 8" stroke of slide with 6" adjustment, electrically controlled air-operated Cleveland (patented) Drum Type Clutch with spring loaded brake, auxiliary air brake on flywheel, and completely enclosed gears running in oil.



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# ACCURACY



*... to millionths of an inch*

Accuracy that's a must for tool rooms . . . so fine it can be measured only by a light bounce, so precise it produces micro-inch finishes at production speeds. This is the accuracy you get in the No. 560 Grand Rapids Precision Tool Room Type Hydraulic Feed Surface Grinder . . . accuracy assured by such features as hand-scraped V-shaped ways, rigid one-piece column and base casting, truly automatic cross feed and extra-heavy spindle. Why settle for less?

For information on the No. 560 or the Nos. 550, 360 and 350 Tool Room Type Surface Grinders, send a note on your letterhead.



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260 For more data circle this page number on card at back of book



Robert L. Walker, manager, Cleco  
Division of Reed Roller Bit Co.

the expanding division. He had served as coordinator of engineering operations with sales prior to his recent appointment.

### England

NATIONAL BROACH & MACHINE Co., Detroit, Mich., has announced the formation of an associate company in England to manufacture, sell, and service Red Ring gear-production equipment, super precision ball screws, and precision boring heads to British, European, and world markets. The new company, which is named PRECISION GEAR MACHINES & TOOLS, LTD., is located at Coventry, England. GEORGE E. K. BLYTHE will serve as managing director.

## Coming Events

NOVEMBER 3 and 4—Annual Regional Conference and Convention of the American Institute of Industrial Engineers to be held at the Sheraton Plaza Hotel, Boston, Mass. For further information: Marshall Schneider, chairman, publicity committee, American Institute of Industrial Engineers, Inc., Boston, Mass.

NOVEMBER 8-11—First National Die Casting Exposition and Congress to be held in the Detroit Artillery Armory. For further information, inquire of the Society of Die Casting Engineers, 19382 James Couzens Highway, Detroit 32, Mich.

NOVEMBER 14-18—Third Western Tool Show sponsored by the American Society of Tool Engineers, to be

MACHINERY, November, 1960



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held at the Memorial Sports Arena in Los Angeles, Calif. For additional information write Leonard Abrams, exposition manager, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.

NOVEMBER 28-DECEMBER 2—Twenty-Fourth National Exposition of Power and Mechanical Engineering to be held at the New York Coliseum. For more information, contact E. K. Stevens, exposition manager, International Exposition Co., 480 Lexington Ave., New York 17, N. Y.

## New Books and Publications

VALUE ENGINEERING 1959: EIA Conference on Value Engineering. 165 pages; illustrated; 6 by 9 inches. Published by Engineering Publishers, P. O. Box 2, Elizabeth, N. J. Price, \$6.

This book contains the complete versions of all of the technical papers presented at the Electronic Industries Association Conference on Value Engineering held at the University of Pennsylvania on October

6 and 7, 1959. This was the first comprehensive industry conference on this subject. The papers cover basic concepts and philosophies, techniques, application, and relationship with other work areas. Customer, manufacturer, and vendor viewpoints are represented.

Value engineering, or value analysis as it is frequently called, is a relatively new engineering specialty which originated in naval shipyards a few years ago. Several important electronic equipment manufacturers, among others, have since adopted its principles.

PRACTICAL DESIGN OF SHEET METAL STAMPINGS. By Federico Strasser. 175 pages; 6 by 9 1/4 inches; 555 illustrations. Published by Chilton Co., Philadelphia, Pa. Price, \$10.

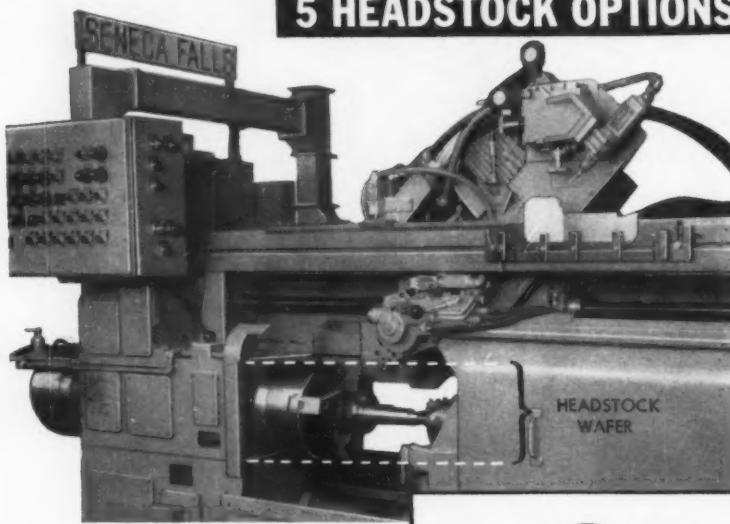
Stamping technique used in the pressworking of metals is based principally on practical knowledge, and the information which the author has gathered in this book will be valuable to anyone engaged in or interested in the production of articles made of die-produced components. It should prove to be a helpful reference for practicing mechanical designers, draftsmen, and engineering students.

Metal stampings, made by processes which permit mass production at low cost, are used not only directly in many consumer products but also for parts in various machines, tools, and automatic devices. This book shows those factors in the design of metal stampings which bring about economical and trouble-free production, and also how this kind of production may be achieved by intelligent application of basic rules and concepts of stamping technique.

MECHANISM. Fifth edition. By Virgil Moring Faires and Robert McArdele Keown. 332 pages; illustrated; 6 by 9 inches. Published by McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y. Price, \$7.50.

This all-new fifth edition details and explains the numerous technical developments and advancements in the field since 1939. Intended primarily as a working text, the book is written in clear, lucid language, offering a practical treatment of the more common engineering problems on motion.

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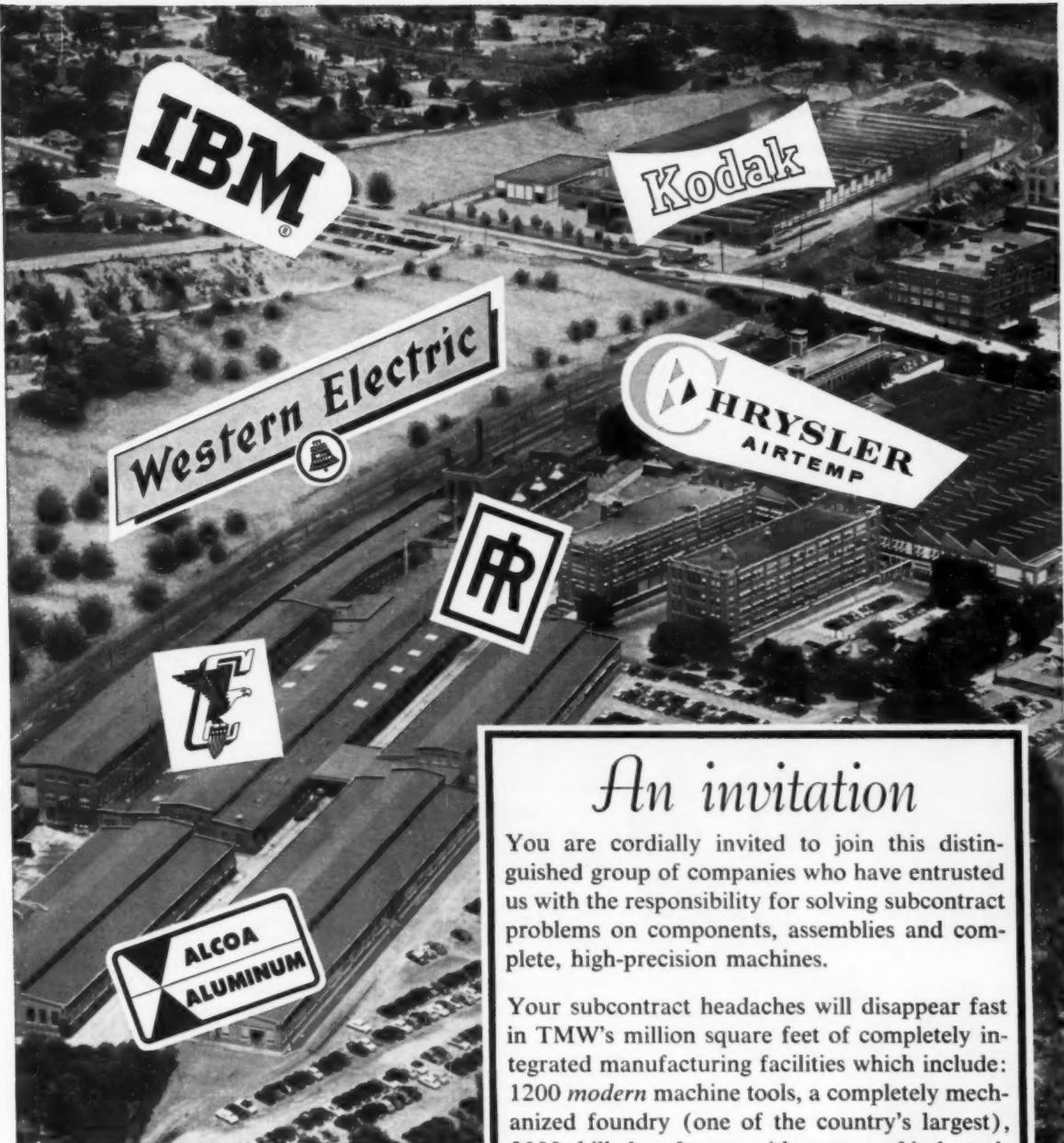
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Also new in this edition are the problems intended for graphical solution. They are so set up that they can be plotted with a minimum of supervision, making this book particularly helpful to undergraduate sophomore mechanical and electrical engineering students.

**WORK SAMPLING FOR MODERN MANAGEMENT.** By Bertrand L. Hansen. 288 pages; illustrated; 6 by 9 inches. Published by Prentice-Hall, Inc., Englewood Cliffs, N. J. Price, \$7.50.

This is a practical guide providing a new and economical tool for management in measuring work through easy-to-use, reliable sampling techniques. Offering an effective, step-by-step explanation on how to make a profitable fact-finding sampling study from the initial planning stage to the last step of the follow-up, this volume shows how modern management can solve many major problems presented by the current rising cost of indirect labor and increasing replacement of people by machines.

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**OIL HYDRAULIC POWER AND ITS INDUSTRIAL APPLICATIONS.** Second edition. By Walter Ernst. 466 pages; 6 by 9 inches; 350 illustrations; 29 tables. Published by McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y. Price, \$12.50.

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The author deals with all aspects of fluid mechanics as applied to oil under pressure: oil flow characteristics, viscosity, and behavior in hydraulic machinery. Each stage of the hydraulic system is discussed, including the generation of oil hydraulic power by all types of rotary pumps; its use in rotary and reciprocating motors; its control by suitable valves; and its transmission through piping, tubing, and fittings. How these components are co-ordinated into a useful working mechanism is fully covered.

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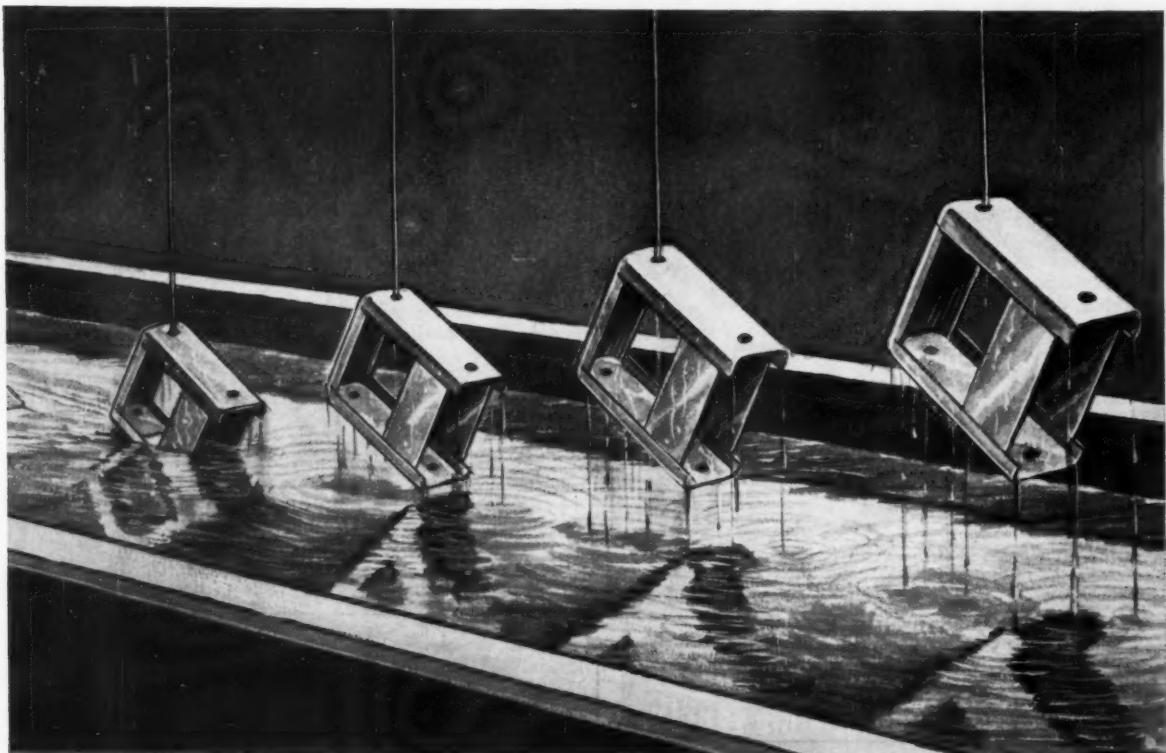
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**AMERICAN STANDARD CAST-IRON PIPE FLANGES AND FLANGED FITTINGS** — Class 125, ASA B16.1-1960 and Class 250, ASA B16.2-1960. 20 and 19 pages, respectively; 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39 St., New York 18, N.Y. Price, \$1.50 each.

These standards cover the pressure ratings; sizes and method of designating openings of reduced fittings; marking; minimum requirements for materials; dimensions and tolerances; bolt, nut, and gasket dimensions; and tests for the Class 125 and Class 250 cast-iron pipe flanges and flange fittings. Sponsors other than the ASME include the Mechanical Contractors Association of America and Manufacturers Standardization Society of the Valve and Fittings Industry.

**AMERICAN STANDARD MILLING CUTTERS**. ASA B5.3-1960. 73 pages;

8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39 St., New York 18, N.Y. Price, \$3.

This standard covers milling cutters of one-piece construction. It gives general definitions, descriptions (including halftone illustrations), classifications, nomenclature of elements, dimensions, and tolerances. Sponsors other than the ASME are the American Society of Tool and Manufacturing Engineers, Metal Cutting Tool Institute, Society of Automotive Engineers, and National Machine Tool Builders' Association.

**AMERICAN STANDARD LARGE RIVETS**. ASA B18.4-1960. 14 pages; 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39 St., New York 18, N.Y. Price, \$1.50.

Included in this standard are rivets 1/2 inch in nominal diameter and larger. Tables of principal dimensions of the various types of rivets as well as tolerances for these dimensions and rivet lengths are given.

Dimensions of manufactured heads after driving for some head types and for hold-on (dolly bar) impressions are also included in this standard.

**AMERICAN STANDARD—IDENTIFICATION CODE FOR BALL AND ROLLER BEARINGS**. ASA B54.1-1960. 44 pages; 8 1/2 by 11 inches. Published by American Standards Association, Inc., 10 E. 40 St., New York 16, N.Y. Price, \$4.

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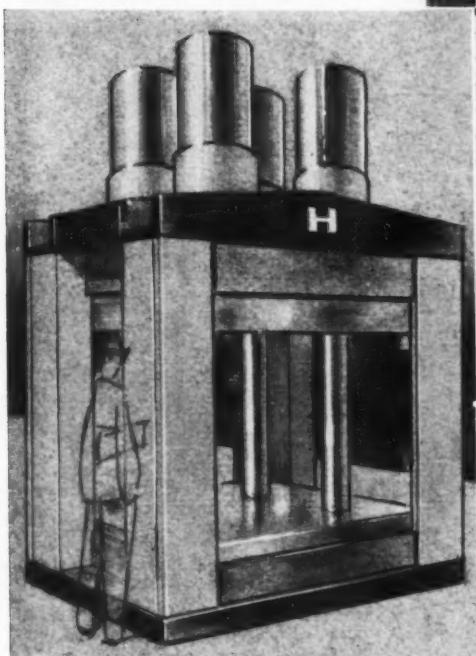
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- No. 34 Brown & Sharpe, m.d.
- No. 130 Cleveland Vertical Rigid Hobber
- No. 12H Gould Eberhardt Universal Mfg. Gear Hobber, m.d.

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- 18" National Broach & Machine Co.
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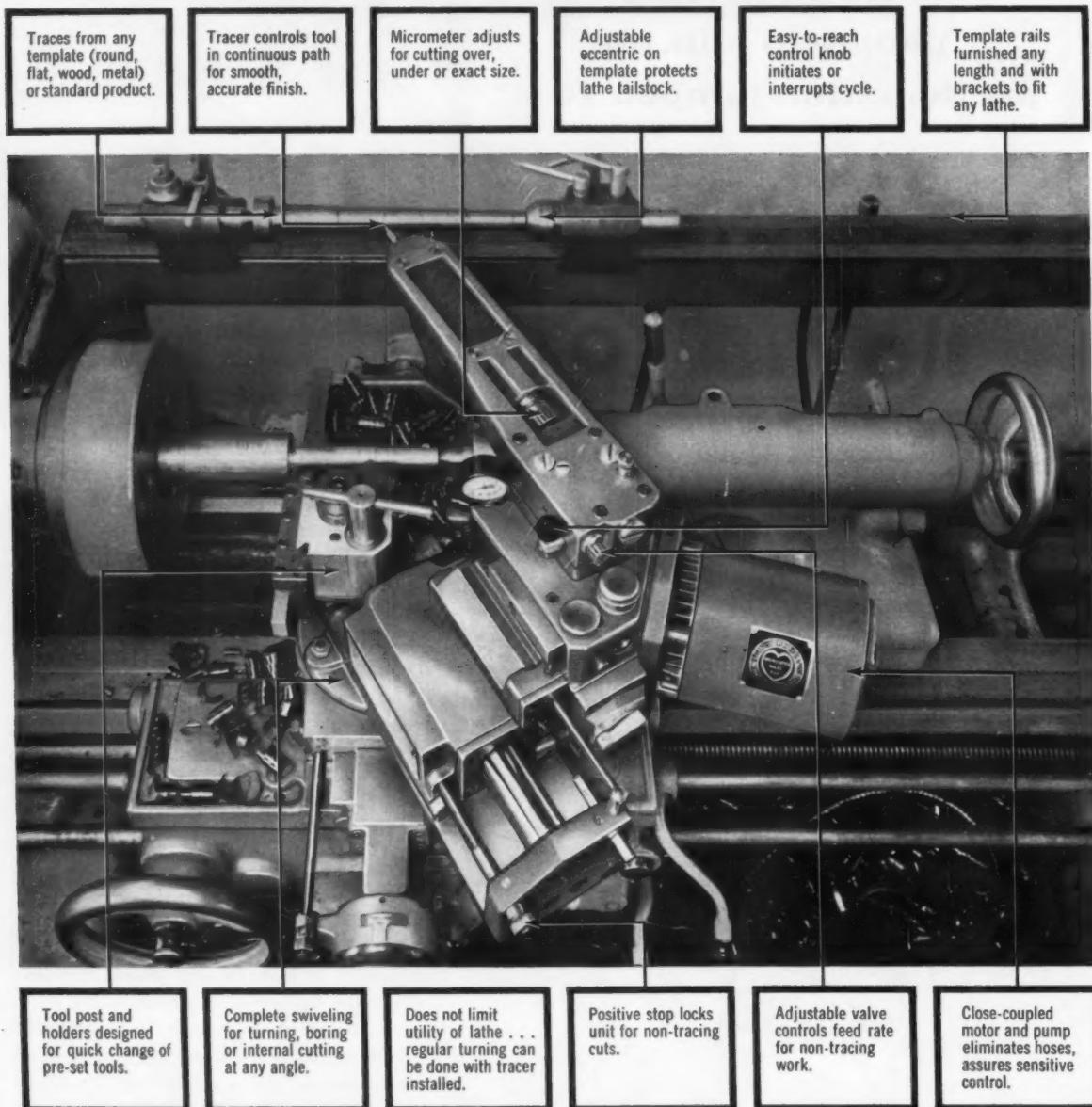
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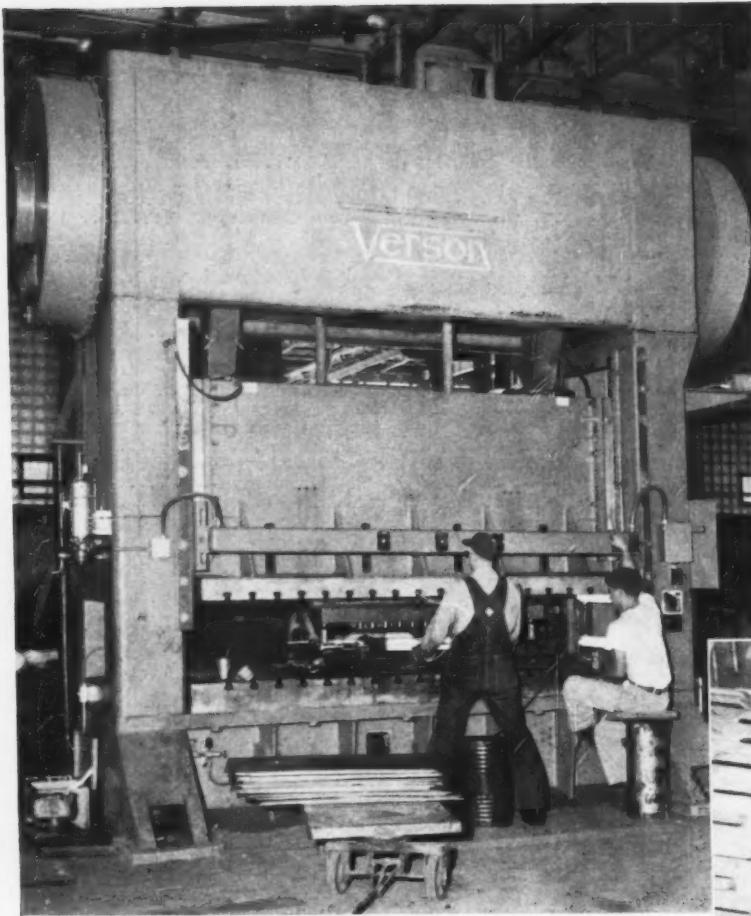


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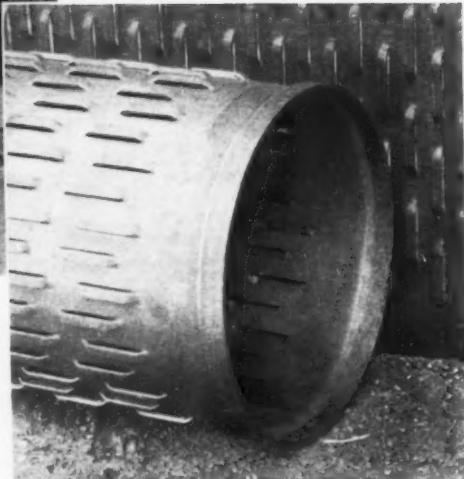
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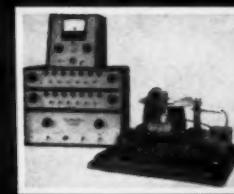
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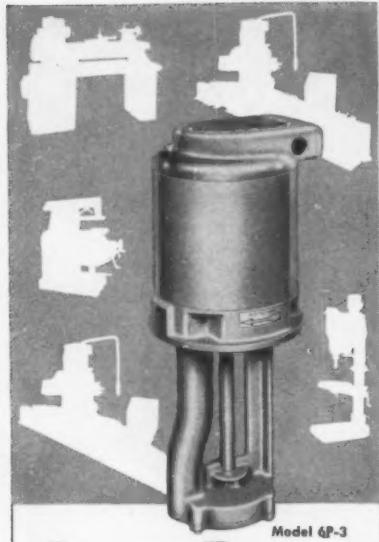
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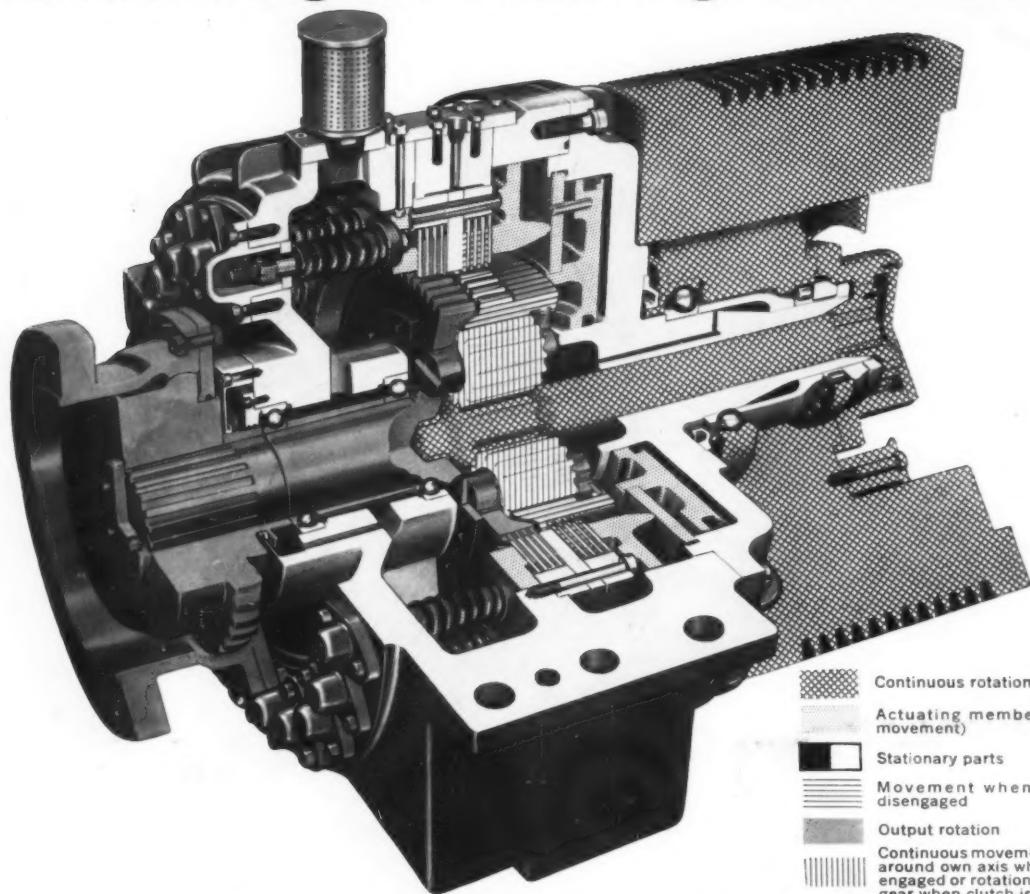
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